RADIO and ELECTRONICS

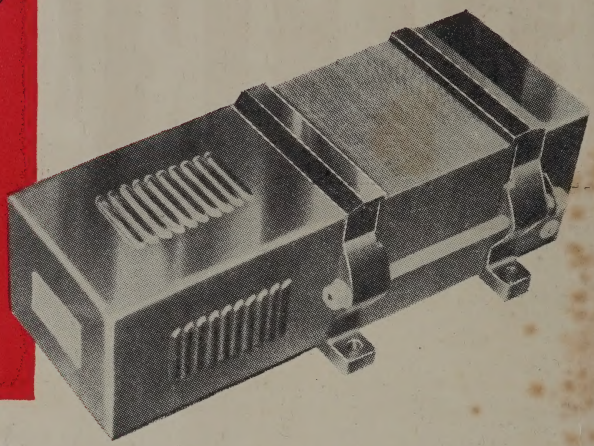
ELECTRICITY — COMMUNICATIONS — SERVICE — SOUND

JUNE 1st, 1951

VOL. 6, NO. 3

1/10

Advance Constant Voltage TRANSFORMERS



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RADIO and ELECTRONICS

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OUR COVER

This month's cover illustrates the main portion of the "R. & E." V.T. voltmeter, the description of which is completed in this issue. The socket on the front takes the connecting plug on the probe cable, the control on the left of the meter is the range switch, and that on the right is the zero-set potentiometer.

•

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Stolen or Missing Radio Sets

Elsewhere in this issue, in a report on the recent activities of the New Zealand Radio Traders' Federation, will be found a reference to the fact that the Federation is taking steps to obtain, and circulate to its members, current Police Department information on stolen or missing radio sets.

The machinery for this service has already been set in motion, and this journal has received the first cyclostyled sheet of information, as sent out by the Federation. This document makes extremely interesting reading, and, in addition to underlining the commendable speed with which the Federation's Executive has implemented a useful service to its members, makes one realize, far better than can any simple statement of the aims of the service, just how valuable the information can be to radio dealers and others who for any reason are likely to come into contact with used radio receivers.

Most people, it is thought, would initially visualize a list of missing radio sets as a dry statement of the make and serial number of each set, with perhaps the addition of the name of the place from which the set was stolen, or went missing. Such a list, while useful, would not perhaps make very interesting reading. It would also throw no light at all on the pertinent questions of (a) the probable identity of the culprit, or (b) the method used for unlawfully alienating the set from its rightful owner.

To the average man who never gives a thought to the problem of how to go about stealing a radio set, a stolen set, if it brings to mind anything in particular, simply suggests the usual expedient of thieves, of waiting until no one is looking and then nipping off with the set under his arm at as high a velocity as possible. But this first list of stolen radios would indicate that slippery gentlemen of a lawless turn of mind, and considerable resource to back it up, are by no means confined to London, New York, or the pages of sensational fiction! Indeed, two of the three cases quoted in the list give complete details of the *modus operandi* of two of these worthies who, far from adopting the conventional method of stealing, actually walked out of dealers' shops with the loot under their arms, and with the full concurrence of the unfortunate dealers themselves! In fact, one of the thieves performed the same trick twice in the same evening, in the same town, but on two different dealers.

It is of no assistance at all to say that the dealers concerned should not have been so trusting; they did no more than they probably do for honest citizens several times a week, and the fact that they were on these occasions taken in is merely a sad commentary on human nature, and a practical demonstration that people are not always what they seem. The important point is that if details of such shady transactions are published for all to read, those who are in a position to be hoaxed will be forearmed and will presumably take what steps they can to prevent similar dodges from being worked again. One well-proven method of scotching "rackets" like the ones to which we have been referring is to publicise the methods employed, and it is our considered opinion that the promulgation to its members by the Traders' Federation of the information gathered by the police will be of great assistance in stamping out such practices. There is always, in addition, the advantage that through the agency of dealers and servicemen who have by them lists of stolen sets, some of the light-fingered gentry may be brought to book.

It is therefore with great pleasure that we announce that, as from the July issue, the lists of stolen radio sets will be published in this magazine from month to month as they come to hand. Unfortunately, it was not possible to print the first list in this issue, as it arrived too late for inclusion. We would like, however, to thank the New Zealand Radio Traders' Federation, on behalf of the whole of the radio trade, for making the information freely available, through our pages, to everyone, irrespective of whether or not he may be a member of the Federation. This is a most public-spirited action, and illustrates to the full the good that such trade organizations can do for their own section of the trading community.

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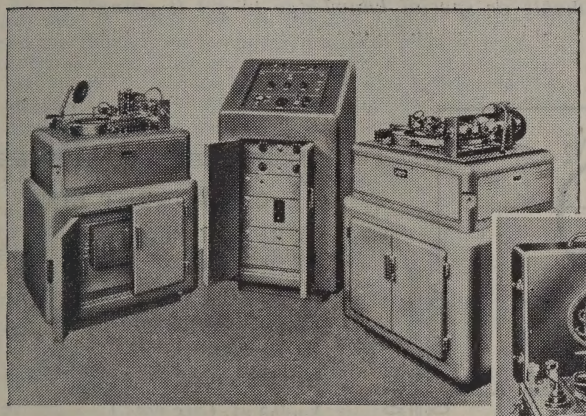

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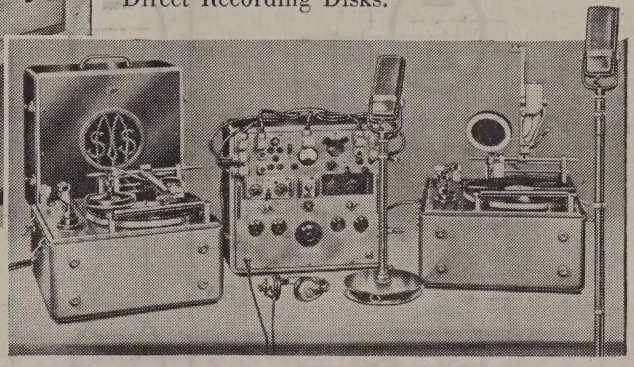

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Right: PORTABLE STUDIO EQUIPMENT—Type SP/2/1, designed to make really high-class recordings on disks up to 13 in. in diameter, under practically all conditions of studio, concert-hall, or open-air performance. Two separately controlled microphone inputs, line input and output, and full controls give facilities not previously possible in portable recorders.

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accessories . . .

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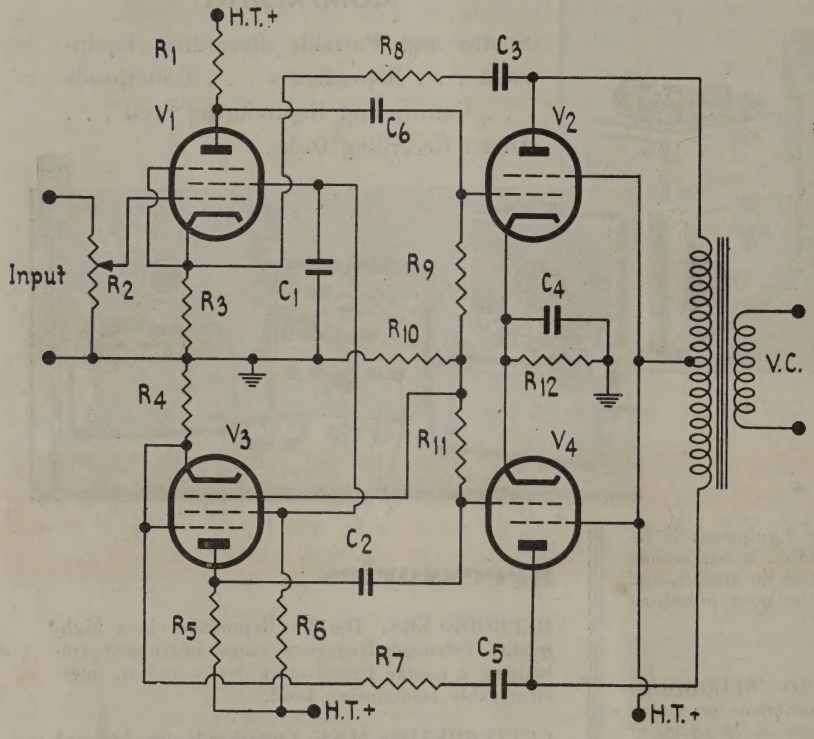
The "R. and E." Beginners' Quality Amplifier

The amplifier described in this article has the virtues of excellent quality and extreme ease of construction. It also lends itself to the use of a wide variety of valves, making it an excellent one for those who wish to make use of equipment that is available in the workshop. There are no critical adjustments, and it has been designed to require no advanced instruments or special knowledge to get it going.



COMPONENT LIST

R_1, R_5, R_9, R_{10}, R_{11}, 250k.
R_2, 500k. pot.
R_3, R_4, 1500 ohms.
R_6, 250k. (see note).
R_7, R_8, 500k.
R_{12}, 125 ohms.
C_1, 0.5 μf. (See note.)
C_2, C_3, C_5, C_6, 0.1 μf. 600v.
C_4, 25 μf. 25v. electro.
V_1, V_3, 6AU6.
V_2, V_4, 6AQ5 or 6V6.
Output transformer, 10,000 ohms to voice-coil.
H.T., 250 volts.

INTRODUCTION

Once upon a time, before the development of all the super-high-quality amplifiers that have been seen of recent years, amplifiers were almost always easy to build, and required no great technical knowledge or complex test equipment to get them going properly, as long as the circuit was followed faithfully, and provided the constructor took heed of a few simple tips given by the original designer. It was therefore possible for the veriest newcomer to valves and their circuits to build himself an audio amplifier that would be as good as the next man's, and which could be relied upon to stay that way, barring dry joints or other constructional imperfections. Nowadays, though, the situation is rather different. Circuits have been developed that enable hitherto undreamed of figures of distortion to be obtained—at a price. This price has to be paid if the builder of amplifiers is to be certain that his gear will work properly, and if it remains unpaid, then the reward is more than likely to be an amplifier which not only does not come near to fulfilling original expectations, but which actually performs a great deal worse than would a less pretentious design not so difficult to carry out.

The price we have been talking about includes increased complexity, increased cost of certain parts, a very high degree of negative feedback. It is in the latter two points that trouble is likely to be met, and, sad to say, is met by many who atempt these advanced designs. Distortion figures of less than 0.25 per cent. can readily be obtained with modern circuits, but it by no means follows that this performance *will* be obtained, and it is to ensure that it is, that causes all the difficulty.

BACK TO SIMPLICITY

What, then, if anything, can be done about it? The answer is simply this: that if a *slight* loss of performance can be put up with, quite a lot of difficulty can be overcome. In fact, we would almost go so far as to say all of it.

At this, there will no doubt be many murmurings from those who say that in an amplifier, nothing but the best is good enough, but here, as in many other places, there is room for argument. For example, few of us can afford to buy the best that is offering in, say, loudspeakers or gramophone pick-ups. We realize this, and with a sigh, go off and purchase the best our pocket will allow us to, saying to ourselves "It may not be as good as old Tom's, down the street, but never mind, it will

be pretty good for all that." What we want to point out here is that the same considerations as apply to speakers and pick-ups, which, in general, we do not make ourselves, can also apply to amplifiers, which we do. It all depends what an amplifier is to be used for whether or not anything less than the best will do. And besides, unless we can pay the price of a high-fidelity output transformer, we cannot have the best possible amplifier in any case, since the output transformer is part of it. By all means let us build the best amplifier we can afford, and of which we are capable, but let us also regard the thing from the purely practical point of view at the same time. This is what we have done in designing this amplifier, and we think it will give a great deal of pleasure to many who have neither the cash nor the facilities to ensure that a super-high-quality amplifier is really what it sets out to be. People may talk about frequency response up to 20,000 c/sec., and 30 db. of negative feedback as long as they like, but the fact remains that such an amplifier is worse than useless, and worse than the simplest amplifier without any of the modern "frills" if it is not working properly.

THE CIRCUIT

Before going to detail, let us see what this amplifier circuit has to recommend it. Here are a list of its features:

(1) Frequency response limited only by the quality of the output transformer.
(2) Distortion less than 2 per cent. total.
(3) Negative feedback used, but in such a way as to introduce no constructional difficulties, *e.g.*, the amplifier cannot oscillate if a particular output transformer is not used, or if valves are replaced.
(4) Fully loaded from an output of 0.5 volts peak, *i.e.*, adequate gain for all purposes, except low-level pick-ups or microphones.
(5) Only two stages used, so that if an extra stage is added for working with a low-level microphone or pick-up, no difficulties will occur through motor-boating.
(6) Extreme flexibility. Any type of output pentode can be used simply by changing the cathode resistor to the recommended value for the tube used, and perhaps altering the output transformer ratio to suit. Different types of voltage amplifier pentode can also be used, provided cathode and screen resistors are changed according to the usual resistance-coupled data available in the valve books, to suit the valve used. Also, altering the speaker to one of a different impedance will affect only the output transformer needed, and not any of the circuit values.

There are other points that could be mentioned, but the above list ought to be enough to go on with!

The circuit uses a phase inverter that is not used a great deal these days, but which has several points in its favour. If, as here, it employs high-gain pentodes, the balance is quite good enough for all ordinary pur-

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poses, and is obtained automatically, without any adjustments whatever. It also provides at the same time all the amplification that is needed ahead of the power valves, so that although two pentodes have been used, the total number of valves is still only four, and the sensitivity of the amplifier is such that 0.5 volts peak signal is enough to give full power output from the amplifier, and, of course, most of the time a considerably smaller input signal will actually be used. With ordinary resistors used in the phase-inverter circuit, and without any special attempt to choose exact values, the balance of the push-pull output provided by the phase inverter will be within 5 per cent., and this is a figure that is perfectly adequate for all but the most stringent requirements. A further advantage of the circuit is that, owing both to the negative feedback and to the self-balancing properties of the circuit, no noticeable change in performance will occur if any of the valves are changed, or if both valves of the same type are not identical.

Apart from the phase inverter circuit, all we have is the output stage, which is quite conventional in all respects. The power supply needs to give 250 volts at 100 ma., and with 6V6s or 6AQ5s in the circuit, the power output will be between 8 and 9 watts, with the low distortion and good frequency response mentioned above.

LAYOUT AND CONSTRUCTION

The amplifier is so simple and straight-forward that we have not printed photographs of the completed amplifier. Builders will have no difficulty in getting it to work, whatever type of parts layout is adopted. It is suggested that the valves be arranged at the corners of a square, that can be made just large enough to enable the coupling condensers to be wired directly from the plates of V_1 and V_3 to the grid terminals of the output tubes. 8he feedback condensers from the plates of the output tubes can be mounted directly to the plates of these valves at one end, and insulated solder tags mounted on the chassis to take the other ends. These tags can be placed at the right distance from the cathode pins of the voltage amplifier valves to enable the feedback resistors to be mounted directly from the tags to the cathods.

Since building the oriignal circuit, shown here, we have found only one source of possible trouble. It is in the use of a common dropping resistor for the two 6AU6s. With some valves, this connection was found to induce a very slow motorboat, or low-frequency oscillation, but it was found that this could be completely cured by using separate 500k. screen resistors. When this is done, it is of course necessary to use a screen bypass condenser at each screen. This modification adds only one resistor and one condenser to the not very formidable list of parts.

Another point to watch is the way in which the heater winding is earthed. Very often it is possible to earth one side of the winding directly, but with this high-gain circuit it is best to wire two 50-ohm resistors in series, earth the centre point, and connect each end to one of the heater lugs on the power transformer. This effectively removes hum from this source, and there is no need to go to any further lengths than this to reduce it to an acceptable level.

As it stands, the amplifier will be found admirably suited to handling the output of a radio tuner or that of any ordinary gramophone pick-up, such as a crystal or simple magnetic type. However, those pick-ups which require a bass compensating network in order to give the output the necessary flat characteristic will need a further stage of amplification, although only a low-gain

(Continued on Page 48.)

Mullard
VALVE NEWS

MULLARD GAS TRIODE EN31

Of the many applications of Thyratrons, time base generation has always been the most widely used. The main reason for its popularity is its ability to change suddenly from zero to heavy current in order to discharge a capacitor so quickly that the flyback is accomplished in an extremely small fraction of the whole cycle. By contrast a hard valve time base requires some amplified triggering arrangement in order to speed up the discharge, and even then is not such a low resistance switch.

In a soft valve, directly any appreciable electron current commences to flow through low-pressure gas, the molecules are ionized, forming an electrically-neutral, highly-conducting cloud, the action being as if the anode were suddenly moved to within microscopic distance of the cathode, thereby causing negligible space charge for the anode voltages to overcome. While the control grid is smothered by the conducting cloud, it ceases to control, until the discharge ends through lack of voltage to maintain it. The function of the grid is then to determine, by the negative bias applied, the anode volts required to recommence, and hence the amplitude of the time base voltage.

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The MULLARD EN31 *has numerous applications apart from time bases, and its characteristics are shown below.*

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DESIGN SHEET No. 11: Input Impedance of Folded Dipoles

The folded dipole has become very well known among professional and amateur radio men alike, mostly because of the ease and convenience with which it may be fed. This useful feature is brought about by the fact that the simple folded dipole, illustrated in B of Fig. 1, has an input impedance that is four times that of a standard single-wire dipole. As is well known, the common or garden type of folded dipole can be fed with an untuned or "flat" line of characteristic impedance 300 ohms, without any intermediate matching arrangements, and without introducing a great enough standing wave ratio to cause trouble through R.F. losses or radiation from the feeders. For feeding a folded dipole, therefore, it is common practice to use commercially available 300 ohm "ribbon," and thereafter to forget all matching worries, provided only that the aerial is cut to the correct length for the operating frequency.

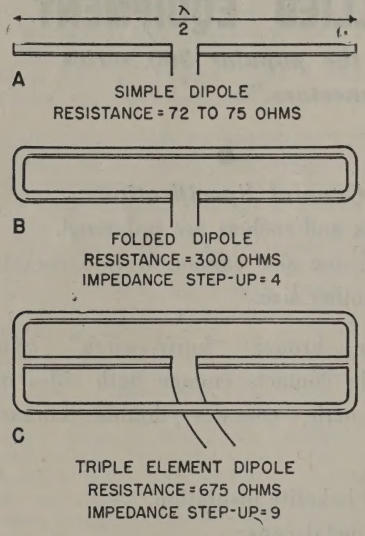


Fig. 1

What is perhaps not so well known, is the fact that the common folded dipole is only one of an infinite number of folded dipoles that can be constructed for a given frequency, in such a way as to give almost any desired input impedance. It must often happen that perfectly good feeder line is already installed in position, the only difficulty being that its impedance is not 300 ohms. If under these circumstances it is desired to use a folded dipole, in order to take advantage of its inherent matching qualities, it becomes necessary to scrap the existing feeders, and replace them with new ones built to have an impedance of 300 ohms. This can mean considerable expense, which can be avoided altogether if it is known that folded dipoles can be made that have almost any input impedance that may be desired. For example, if a three-wire arrangement such as C in Fig. 1 is made, using for all three legs wire of the same diameter, and having equal spacing between all three wires, we get an impedance step-up of nine times, which brings the input impedance very close to the 600-ohm mark—certainly near enough to enable us to use existing 600-ohm feeders without sensible mismatch.

OTHER STEP-UP RATIOS

The above example, however, by no means exhausts the possibilities, for so far, we have been considering only folded dipoles in which the two wires have identical diameters. If the wires are given different diameters, then it is found that the input impedance depends (a) on the ratio between these diameters, and (b) on the centre-to-centre spacing of the two wires. This being the case, it is possible to work out the input impedance of any two-wire folded dipole, given the spacing and the ratio

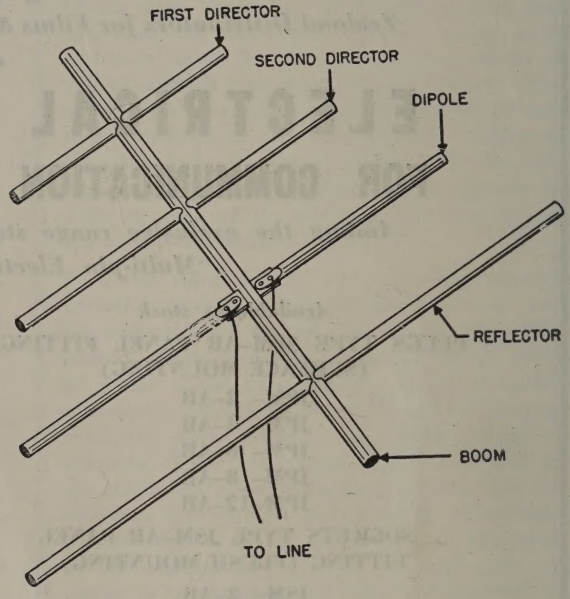


Fig. 2

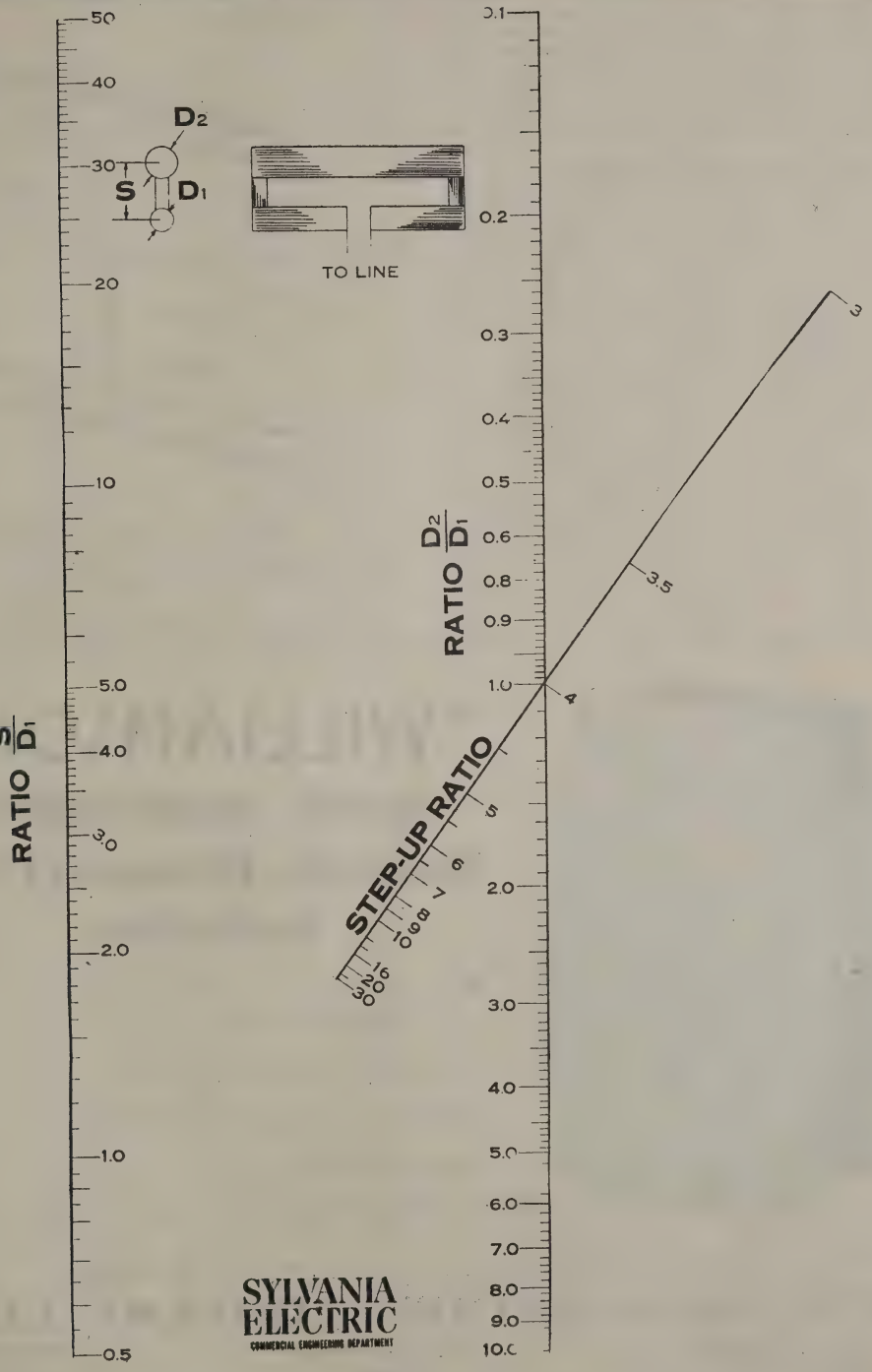
of diameters. To save the use of relatively complicated formulae, this calculation has been reduced to the form of a chart, which, together with a straight-edge, enables the input impedance to be found if the two ratios referred to are known, or either ratio to be found if the input impedance is decided, and the other ratio is fixed arbitrarily. For example, it may be desired to use existing 800-ohm feeders, and the wires that are available for making the folded dipole from may have a ratio of four to one in diameter. The question then is, what spacing must be used if the folded dipole is to match the 600-ohm line? This question can be answered simply by placing a ruler across the chart from the point 4.0 on the scale marked D_2/D_1, to a point on the diagonal line corresponding to the required step-up ratio. The latter must, of course, have been worked out beforehand. In the present case, the step-up is from 72 ohms (the impedance of an ordinary dipole) to 800 ohms, or a ratio of 11.1 to 1. The ruler is thus placed from 4.0 on the D_2/D_1 scale, to 11.1 on the step-up ratio scale, and the point is noted where the ruler cuts the S/D_1 scale. The answer given by the chart is $S/D_1 = 5.75$.

Suppose, then, that the smaller wire has a diameter D_1 of 1/16 in.; the answer for the required spacing would then be $1/16 \times 5.75 = 0.36$ in. This is not presented as an example of good design, because mechanical

(Continued on Page 10.)

IMPEDANCE STEP-UP CHART

FOR A FOLDED DIPOLE ANTENNA



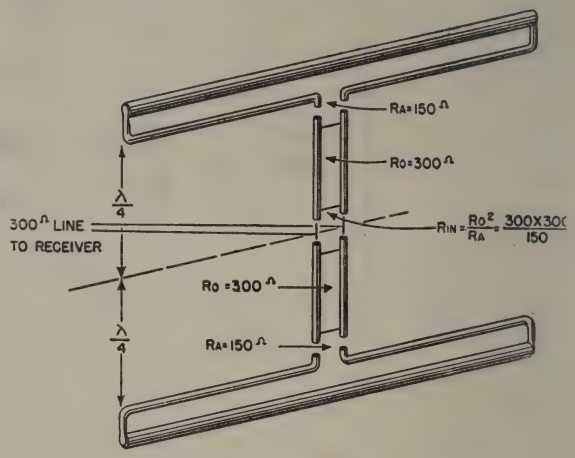
SYLVANIA ELECTRIC

COMMERCIAL ENGINEERING DEPARTMENT

considerations play their part, as always, but it does serve to show how the chart works, and what can be done with it. Actually, for a V.H.F. folded dipole, where the larger "wire" would obviously be a quarter inch rod, short enough to be self-supporting, or almost so, this would be quite a practical aerial to build, but obviously for lower frequencies, where thinner wires would have to be used on account of cost and weight, it would not be very practical, and we would have to start again. But it takes so little time to work out an example that this would certainly not be any hardship.

USE WITH YAGI ARRAYS

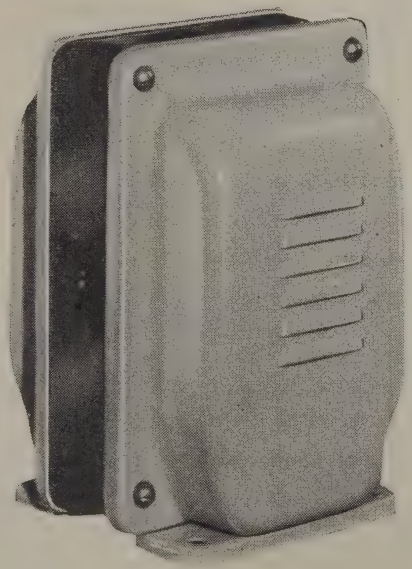
The name "Yagi" refers to any dipole to which has been added a reflector and one or more directors. It is well known that such arrays alter the input impedance of the fed element considerably, and in a simple Yagi array as shown in Fig. 2, the input impedance, if a simple dipole is used, is in the region of 25 ohms. It then becomes a matter of some importance to get a high step-up ratio in the folded dipole, because transmission lines of 25 ohms are not practicable. Now it is a rule that whatever the impedance of a simple dipole may be, whether or not it has been lowered by making it part of a directional array, the impedance step-up obtained by using a given type of folded dipole instead is not affected. Thus, if an ordinary two-wire folded dipole, with equal diameters, were used in the array of Fig. 2, the input impedance would be 4 x 25 = 100 ohms. Similarly, if the three-wire dipole of Fig. 1 (C) were used, the input impedance would be 9 x 25 = 225 ohms. If a four-wire dipole should be used, the impedance would be 16 times 25, or 400 ohms. It is for this reason that the chart has been drawn in terms of impedance step-up ratio, rather than directly in impedance. If you see the input impedance quoted for any array in which the driven element is a simple dipole, it is an easy matter to design a folded dipole to bring the input impedance up to a suitable figure for feeding.



OTHER AERIAL ARRAYS

Folded dipoles can also be used in other aerial arrays in which more than one element is driven, as in Fig. 3,

(Concluded on Page 48.)



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PART II

THE CIRCUIT (Continued)

The input circuit is so arranged that the lower portion of the signal voltage divider, R_5, is at the same time part of the filter which prevents signal frequency voltage from being applied to the grid of the meter valve. When the input signal is applied to the diode, the resulting negative D.C. output voltage is in the direction which decreases the plate current of the left-hand half of the 6SN7. Since the valve is a cathode follower, the cathode is driven negative by the same amount. But no signal is presented to the right-hand half of the 6SN7, whose plate current does not change. A voltage thus exists between the two cathodes, and the meter is deflected. Now because of the cathode follower action of the triodes, the cathodes are points of low impedance, and can thus supply a reasonably large current without causing any change in the voltage at either cathode. It is therefore possible to use the meter as a voltmeter, and provide it with multiplying resistors, just as is done in an ordinary multi-range voltmeter. It is possible to use a quite simple formula in order to work out the resistors that are needed for giving the required full-scale readings, but such a procedure will not give very good accuracy, because the formula contains a figure for the mutual conductance of the valve, and this is not accurately known. If it were, it would be entirely possible to put in calculated values for the meter series resistors, and thus avoid altogether the nuisance of calibrating the meter after its construction has been finished. Unfortunately it is not possible to do this, so in actual practice, we must either adjust some fixed resistors to exactly the values which give the desired full-scale readings, or else make part of each resistor variable, and pre-set them while calibration is being performed.

Readers will no doubt choose which method appeals to them most, since adjusting some carbon resistors by filing is time-consuming, but on the other hand costs less than buying the necessary number of potentiometers. Both methods will give the same results in the long run, though, and which is used does not matter from the point of view of the final accuracy of the meter.

A further advantage of not relying on calculation for finding the values of the series resistors is that if pre-set resistors are used, there is no need to have accurately known high-value resistors for R_1, R_2, R_3, and R_4. All that will then be necessary is to match R_1 and R_2, and R_3 and R_4. This can be done even if one has no means of accurately measuring high values of resistance, and the method to be used in this event will be described a little later.

The power supply is very simple, and uses a 6X5 as a half-wave rectifier, out of a 150v-a-side 30ma. instrument transformer. The full 300 volts from the secondary is employed, the centre-tap being taped up and not used. Resistance smoothing is used, because very good filtering is not needed, and because it reduces cost appreciably. For the same reason, the 6X5 is used in preference to a small metal rectifier. The 6X5 does not need a separate heater winding when 300 volts R.M.S. is applied to its plates, which means that the small instrument transformer, with its single heater winding, its quite satisfactory for the job. At the output end of the filter is a voltage divider, giving equal positive and negative

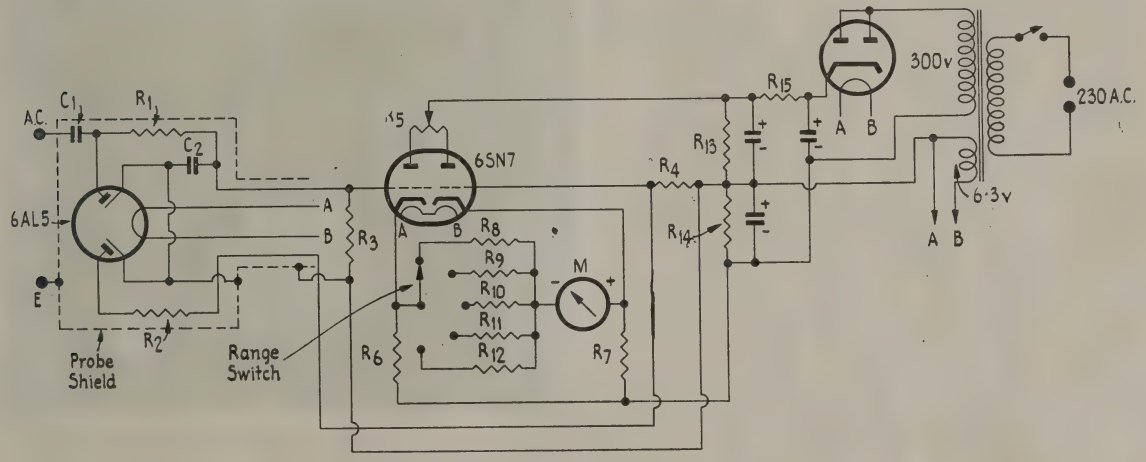


Fig. 1.—Full circuit of the instrument.

COMPONENT LIST

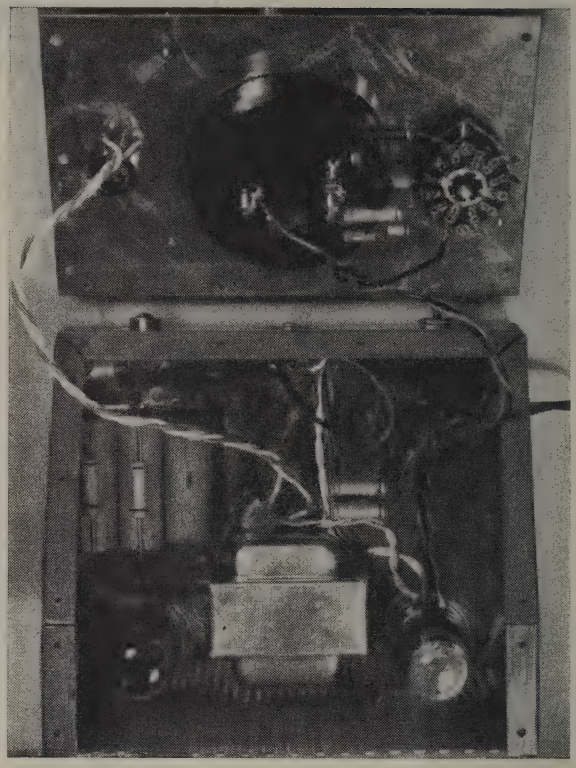
C_1, 0.005 μf., 500v.
C_2, 0.01 μf., 500v.
Electrolytics (unmarked on diagram) 8 μf., 450v.
R_1, R_2, 15 megs.
R_3, R_4, 10 megs.
R_5, 5k. balancing pot.
R_6, R_7, 47k.
R_8, 500 ohms, plus 250-ohm pot. in series.
R_9, 2500 ohms plus 5k. pot. in series.
R_{10}, 10k. plus 10k. pot in series.
R_{11}, 47k. plus 50k. pot. in series.
R_{12}, 150k. plus 100k. pot. in series.
R_{13}, R_{14}, 33k.
R_{15}, 5k.
Rectifier valve, 6X5-GT.

supplies, since the centre point of the voltage divider is earthed, and not the negative end of the supply.

The lower end of the cathode resistors is connected to the negative supply rail, and the plates to the positive rail, while the grid return lead goes to the centre point, and is earthed to the chassis. It would have been possible to let the whole circuit float, not connecting it to the chassis at all, but although this would have one important advantage, it also suffers from rather a serious disadvantage, and it was decided not to use this method. If the whole circuit is left floating with respect to the chassis of the instrument, it would be possible to place both input terminals at any D.C. potential when taking taking a reading. That is to say, a direct measurement could be taken across the plate load resistor, or across the primary of a transformer connected in the plate circuit of an amplifier valve. It would, of course, be necessary to insulate the outer case of the probe if this were done. The disadvantage comes in the fact that it would still be necessary, if stray readings are to be avoided, to earth the "earthy" end of the probe through a condenser. It is earthed in this way, in any case, by the capacity to chassis of the high-voltage secondary of the power transformer; the catch is that every time the input terminals of the probe are connected to a circuit the earthing condenser would charge up, and this takes place through the diode very quickly, giving a momentary but very large surge of voltage to the grid of the meter valve. This surge causes the meter to bang hard over unless it so happens that it is set to its highest voltage range, and because this behaviour is not very good for the movement, it was felt that it would be better to forego the facility of being able to have both input terminals "up in the air" to D.C., and give the added protection to the meter movement. It very seldom happens that a measurement with both input terminals above ground is essential, since in almost all cases the same answer can be had by connecting the "low" end of the input to the chassis of the equipment under test. The biggest disadvantage of this is that it is not possible to reverse the meter input leads in order to measure the negative peak voltage of the signal—the meter reads positive peaks only, on account of the polarity of the measuring diode.

CONSTRUCTION

The construction used for the prototype is well illustrated in the photographs and drawings shown herewith. The front cover shows the external form of the meter. The sloping panel type of cabinet is rather more trouble to make than the conventional box, but is well worth the extra ease with which the instrument can be read and used. The whole box is made in two pieces, as shown in the drawings, and it should be noted that the back is left open, or covered with wire gauze, so as to provide adequate ventilation. There is no chassis, in the conventional sense, everything being mounted directly on to either the inside of the box, or else to the front panel. This does not cause any hardship because there are so few parts, and because the run of the leads is not in the least important, the whole thing apart from the probe, being purely a D.C. device. Both valves are mounted on Amphenol sockets fixed in metal bases, of the kind intended to hold the sockets for through-chassis use. The socket is, however, removed and turned upside down before being replaced, and a hole is bored in the brass base so that the leads can be brought out. The bunched leads can be seen issuing from the sockets in the inside photograph. At the back of the box, in the centre, is mounted the power transformer, with the 6SN7 to the right (in the photograph) and the 6X5 on the left.



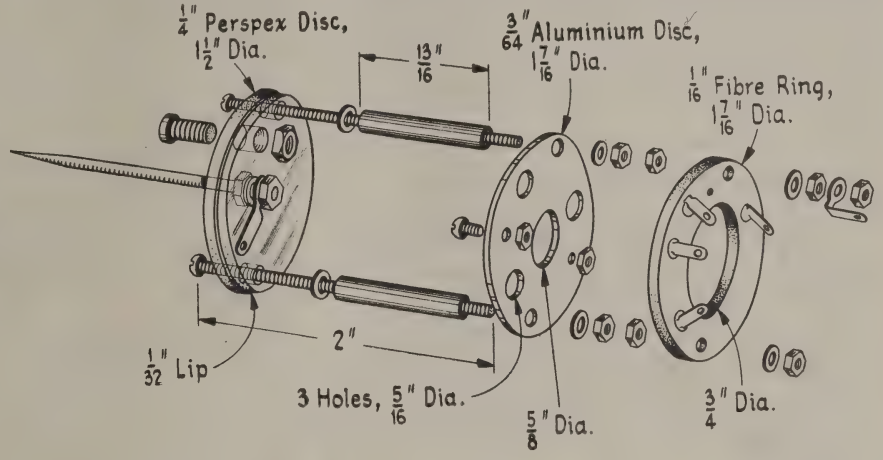
Inside view of the V.T.V.M. The external appearance is featured on this month's front cover.

The electrolytic condensers can be seen mounted on insulated tag strips close to the rectifier tube, while a further pair of strips is provided on the other side of the floor to take the resistors R_3 and R_4, which can just be seen in the photo. On the front of the box are mounted the on/off switch, the socket for the probe cable, and a lamp bezel. The meter, range switch, and balancing potentiometer, are all mounted on the panel. The series resistors are mounted between their respective contacts on the switch, and a short length of heavy wire soldered to a stout lug gripped by the nearest meter terminal. The mechanical part of the construction is in no way critical, and there is no necessity at all for sticking to the original layout. The probe construction is another matter, however, and builders would be well advised to keep to the layout suggested in the photograph shown in last month's instalment of this article. Here we have given an exploded diagram of the construction, which, in conjunction with the photograph, should enable the probe to be duplicated quite easily. The construction of the main box was of aluminium, which is much easier to work, especially for fairly complex shapes like this one, and the panel is held on with self-tapping screws. Rubber feet are provided, two at the front, and one in the centre at the back. Three were used because it is impossible for the instrument to wobble, either because of inaccuracy of the construction, or when placed on a surface that is not level.

HOW TO SELECT THE CRITICAL RESISTORS

By the critical resistors we mean R_1 to R_4 inclusive. The range setting resistors do not count, since they are to be separately adjusted during calibration anyway, and because as long as they are adjustable, we do not need to know their value exactly.

The same thing goes up to a point, for the high-value resistors in the diode circuit that we are now discussing. Their exact values are not so important as the fact that both pairs must give the same ratio of voltage division.



"Exploded" view of the construction of the probe.

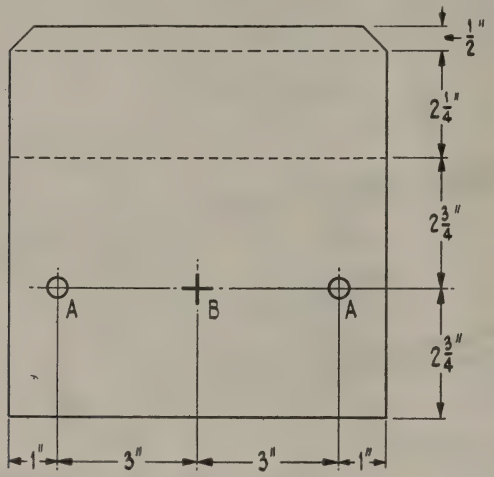
On this will depend to some extent, the manner in which the balanced diode circuit is able to compensate for fluctuations in the heater voltage that will arise as a result of normal line voltage variations. It will be seen from the circuit diagram that R_1 and R_2 are 15 megs. each, and that R_3 and R_4 are 10 megs. It would be very convenient if we could go out and buy resistors of these values with tolerances of, say, 1 per cent., but unfortunately we cannot, and must make the best of the wide-tolerance resistors that can be had. The starting point, therefore, is to procure a number of ½- or 1-watt resistors whose nominal value is 10 megs. The first step is to build the rest of the circuit in its entirety. We then have a D.C. V.T. voltmeter that can be used as a means of matching the resistors. One of the 10 meg. resistors—it does not matter which—is temporarily wired into the position of R_4, and another as R_3. Next, we take a low-resistance potentiometer, say, 1000 to 5000 ohms, and connect it across a single 1½-volt torch cell. The positive end of the combination is then earthed to the chassis, and the first of the resistors to be tested is connected between the moving arm of the potentiometer and the socket pin which connects to the input grid of the 6SN7.

With this set-up, it can be seen that two of the unknown resistors are made into a voltage divider, which applies a fraction of the output of the cell to the input grid of the 6SN7. The procedure is then as follows: The potentiometer is turned fully anti-clockwise so that no voltage from the 1½-volt cell is applied to the input. Then the balancing potentiometer is adjusted until the meter reads zero. The range switch, during the test procedure, should be in the position for the lowest range, where it will be found that the 1½-volt cell will give about two-thirds of full-scale deflection, or less, depending on the value of the series resistor. The main point to note is that during the testing of the resistors, the meter series resistor should be adjusted to a value which gives as large a deflection as possible for a given input voltage, and then NOT TOUCHED, or the sensitivity of the meter will be changed, and the comparative measurements will be of no use.

After the initial adjustments have been made, the meter reading is noted, and a new resistor is substituted for the one connected between the cell and the input terminal. The new meter reading is taken, and if the second resistor has exactly the same value as the first one used in the test position, the reading will be the same as before. All the available 10 meg. resistors are put into the test circuit, and are tagged with their meter reading. It is then a simple matter to pick out the ones which are nearest to each other in value. Because the resistor in the test position is the upper one of the voltage divider (the temporary R_3 being the lower arm) the meter reading will be larger for the smaller resistors in the test position, and vice versa. We now pick out from all the readings two resistors whose readings are (a) as nearly equal as possible, and (b) among the middle range of readings. These two will be used for the permanent R_3 and R_4. Having picked out these two, the others are temporarily put on one side, and the lower of the chosen pair is worked on to bring it up to the value of the higher. This is done by gently sawing a shallow slot in it with a hack-saw. For a start, just get the saw cut going, and replace the resistor in the test circuit. The change in reading may or may not be visible, but as long as the right one has been chosen for filing, its reading should decrease towards the reading of the uncut member of the chosen pair. The sawing is continued slowly, testing at frequent intervals, until the reading is the same as that of the uncut one. When the readings are identical, the resistors have the same value, and these two resistors are ready for wiring permanently into the instrument. It is a good plan, after every bit of cutting on the resistor being adjusted, to let it cool off for about two minutes before taking another check on the meter, because these high-value carbon resistors have an appreciable temperature co-efficient, so that the heat of the sawing or filing alters their value quite considerably. Also, care should be taken to see that the meter zero is accurately set before each reading is taken.

Once the resistors for R_3 and R_4 have been chosen and adjusted, they can be permanently wired into the circuit, and it now remains to choose and adjust the resistors for R_1 and R_2. It is quite a simple matter to bring 10 meg. resistors up to 15 megs. by means of making several

saw-cuts in each one, but so that the amount of sawing shall be a minimum, the resistors are chosen from the original bunch that show that lowest reading in the test circuit, and thus the highest resistance. The important thing is to ensure that the voltage dividers formed by R_1 and R_3, and R_2 and R_4 shall give an output of approximately 0.4 of the input voltage, and the meter is used to measure this ratio rather than the absolute resistance of the resistors. To do this, a further 1.5 volts is added to

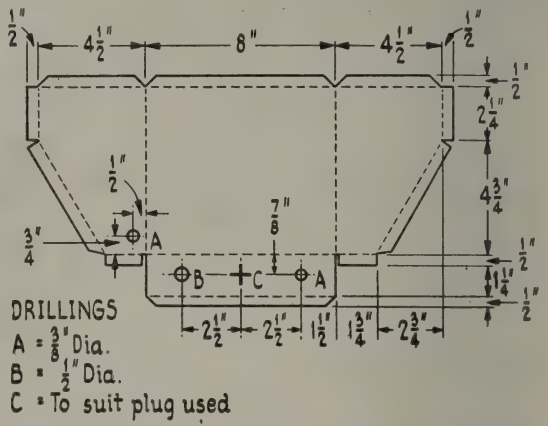


the test cell, and with the moving arm of the potentiometer connected directly to the input terminal, the pot. is adjusted to give exactly full-scale deflection of the meter. The first resistor to be adjusted is then inserted between the moving arm of the pot. and the input terminal. Since its value will be too low, the fraction of input voltage applied to the meter will at this stage be too high, and the meter will read somewhere between half and full scale. The resistor is then adjusted by sawing until without changing any of the controls (except the zero set, to see that the zero remains correctly adjusted) the meter reads 0.4 times full-scale deflection. At this stage, adjustment is stopped, and the next resistor is adjusted in the same way. We now have two resistors which, together with R_3 give the desired voltage division, and which are also equal, so that it does not matter at all which is used as R_1 and which as R_2. They are then wired into position in the probe, and the construction is completed.

FINAL CALIBRATION

The most difficult part of the calibration of the completed instrument is to get hold of an accurate meter with which to match up its readings. It is suggested that a suitable meter is the Avo Model 7, or any similar multi-range meter whose accuracy is known to be B.S.1, or better, on the A.C. ranges. Having done this, we need an oscillator working at, say, 500 c/sec., and with good waveform. It is not advisable to do the calibration at 50 c/sec., using the mains as a source of voltage, because (a) the waveform is not always very good, and (b) because a slight correction factor has to be used at this frequency, and this makes it easier to make a mistake in performing the calibration. If the A.C. meter is not available, or if the oscillator cannot be acquired or built, then it is possible to calibrate the meter using D.C.

However, assuming that the standard meter and the oscillator are available, we proceed as follows: The meter is to be scaled to read *peak* A.C. volts, not R.M.S., because the diode rectifier is a peak-reading device, and peak volts is what it actually measures. Further, by



Left—Front panel; and Above—Cabinet for the V.T.V.M.

scaling the meter to read peak volts, it can also be used, with a different probe, for D.C. readings, *without any* scale *changes,* and this is a most useful facility. The builder can, of course, choose his own ranges, since these depend solely on the values of meter series resistance, and can be picked to suit the meter scale available. The meter in the prototype had two scales, 0–3 and 0–10, which are really the best for any multi-range meter on account of the generous overlap they give, as explained earlier, but if a single scale only is available, reading 0–5, a similar trick can be done by making the ranges 0–5, 0–10, 0–50, 0–100, for example, or, 0–5, 0–25, 0–125, and 0–250. However, it would be well worth while to re-scale any meter used, to have the two scales 0–3 and 0–10, whereupon the required overlap is provided, and also, multiplying factors are restricted to 10 and 100.

Taking the lowest range, of 0–3 volts first, we remember that this reads 3 volts *peak* at full scale, and that this corresponds to 3 x 0.707, or 2.212 volts R.M.S. The calibrating meter is almost certain to be scaled for R.M.S. volts, so that the correct reading to set up on the standard meter is 2.12v., and NOT 3.0v. This is done by connecting both the standard meter and the V.T.V.M. probe to the source of voltage at the same time, and setting the output voltage of the oscillator so that the required reading of 2.12 volts is obtained on the standard meter. Then the appropriate range-setting resistor in the V.T.V.M. is adjusted until the V.T.V.M. reads full scale.

Calibrating the remaining ranges then consists simply of altering the oscillator output to give the required R.M.S. reading on the standard meter, and adjusting the appropriate series resistor in the V.T.V.M. until full scale is indicated. For the 10-volt range, the R.M.S. meter setting will be 7.07 volts, and for the 30, 100, and 300-volt ranges, the settings will be 21.2 volts, 70.7 volts, and 212 volts R.M.S.

It is unlikely that an audio oscillator will give outputs as great as the higher of these voltgaes, so that it will be necessary to use an audio amplifier to get the required output voltage. Any good 10-watt amplifier should be satisfactory, but it might be necessary to use a step-up output transformer, such as a small modulation transformer in order to get the output voltage in such a way that one terminal can be grounded. If no oscillator can be used, it is possible to use the A.C. mains as a source of voltage, by applying a correction factor of 1.06 to the voltage read on the standard meter. This takes care of the fact that the response of the detector diode falls off slightly at frequencies below 50 c/sec., owing to the small size of the coupling condenser used in the probe. It would be possible to increase the value of this condenser, but only at the expense of stray capacity, and therefore of performance at the higher radio frequencies. Thus, when calibrating with 50 c/sec., the required reading on the standard meter will be $2.12 \times 1.06 = 2.25$ volts. If this figure is used for the 0–3 volt range, the figure for the 30-volt range will be 22.5, and so on.

CALIBRATING WITH D.C.

We have already mentioned the question of scaling the meter to read peak volts on A.C., and also to read correctly on D.C. To do this trick, it is necessary to have a probe consisting of a series resistor of 15 megs, so that the same voltage division as occurs with A.C. input, takes place with a D.C. input. This resistor can be and should be of the same value as R_1 and R_2, and not the nominal 15 megs. if D.C. readings are to be correct. The same trick as before can be used to adjust a 10-meg. resistor to the right value, and then, with this done, calibration is performed using the D.C. probe, and a D.C. source of voltage, with the standard meter used on its D.C. ranges. In this case, the standard meter will be set to read the required full-scale voltages, no correction factor of any sort being needed. Batteries can be used for the low voltages, and an ordinary 300-volt power pack for the higher voltages.

A little time spent on calibrating the meter as accurately as possible will be very well spent, and will give the meter a value that it could never achieve otherwise. If the standard meter agrees with itself on the different ranges, it will be found that the V.T.V.M. will also, as the linearity is as good as that of the meter movement itself, except at voltages below 1 volt, and this can be separately calibrated, and a curve drawn if the builder so desires.

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THE NEW ZEALAND ELECTRONICS INSTITUTE (Inc.) NEWSLETTER

BRANCH NEWS

Christchurch

During October 1950 the Christchurch members were given an address in the Recording Studio of the N.Z.B.S. by Mr. T. C. Agar of the recording staff, who described the electrical and mechanical operation of the newly-installed negative feedback cutter heads and their advantage over non-feedback types. Then followed a detailed study of the E.M.I. tape recorders and the valuable property of echo was later practically demonstrated. The circuit diagrams were discussed and the unusual equalization networks pointed out. The second part of the meeting took the form of a practical demonstration of the "disk" and "tape" machines, particular interest being shown in the layout and operation of the E.M.I. recorders. A discussion and practical demonstration followed on noise and distortion measurements, these being carried out on a tape recorder and a limited amplifier, the low values obtained evoking many surprised comments. A general discussion on the frequency response curves required in broadcasting concluded during the serving of supper when the subject of tape recording was discussed in the light of personal experience of the members present.

A further meeting of the Christchurch members was held on the 7th November at which 12 members were present. The chairman opened the meeting with a discussion re the meetings to follow when it was decided that no meeting be held in December or January but that an afternoon visit be made to the N.Z.B.S. transmitting site at Gebbies Pass some time in February. Several speakers which included Mr. Tait, B.Sc., who spoke on the "Comparison of Low Light Intensities by means of Secondary Emission Photocells"; Mr. A. E. McIlraith, M.Sc., who addressed the meeting on "Power-factor Measurement at the Wavelength of 10 cms," and finally Mr. F. A. Johnson, M.Sc., who discussed "Furnace Temperature Control" explaining the difficulties encountered and means of overcoming them, were all students doing advanced research work in the particular subject they discussed.

On the afternoon of the 18th March a visit was made to the N.Z.B.S. transmitting site at Gebbies Pass at which 22 members and visitors were present. Prior to being shown over the transmitting site, members were advised by the chairman that the meeting would be followed by a fuller explanation and description of the things to be seen at the next meeting of the Institute. The Supervising Technician, Mr. H. B. Fletcher, an Associate Member of the Institute, was introduced and proceeded with the assistance of his staff to guide members through the station. The most striking exhibits were the two new 10 K.W. A.W.A. transmitters which are used for 3YA and 3ZB. Members were given a detailed description of the principal features of the transmitters and associated audio equipment. Other points of considerable interest were the new mast with the associated tuning and trap circuits and the unusual construction of the feeder lines. These in principle, are like a concentric line in which the central conductor is represented by two parallel wires, whilst the outer conductor is comprised of four paralleled earthed conductors arranged in the form of a square. Both 3YC and 3ZB transmitters feed the new mast via the "Wave trap" unit situated at the base of the tower. One of the most appreciated aspects of the outing was the excellent afternoon tea very kindly provided by Mrs. Fletcher. At the conclusion of the tour a vote of thanks to Mr. and Mrs. Fletcher and the staff was proposed by Mr. Withers and enthusiastically carried.

Dunedin

A meeting of the Dunedin Branch was held on the 15th March at which 20 members were present. The meeting took the form of a visit to the automatic telephone exchange where the principles of the system were explained in detail by Mr. Harrison. This was followed by a demonstration of the selectors and dialing link-up. The size and complexity of the mechanism necessary was surprising. The sight of the myriads of selectors all busily engaged in searching for numbers and the mechanical ingenuity of their construction particularly with regard to their compactness was a real demonstration of the wonders of electrical engineering. Mr. Harrison then explained on a blackboard the principles of the new carrier system now coming into use. A hearty vote of thanks to Mr. Harrison was carried with acclamation.

Wellington

Wellington members met on the 2nd May and following the business of the evening a combination of address and demonstration was given by Mr. R. E. Grainger, M.I.R.E.(Aust.), A.M.Brit.I.R.E., of the Civil Aviation Branch, on "Long Playing Records." In July last year microgroove or long-playing records were released in England and signified a new and important trend in sound reproduction. The advantages to be gained with this new technique lie not only in its chief attraction, that of long playing, but also in the introduction of a new moulding material which substantially reduces surface noise and which has better wearing qualities than shellac. The equipment on loan for the occasion, consisted of a Connoisseur dual-speed motor and lightweight pick-up lent by courtesy of Messrs. Turnbull and Jones, Ltd., and a three-speed record changer and microgroove records lent by courtesy of Philips Electrical Industries of N.Z. Ltd. Light refreshments were served. A welcome was accorded to F/Lt. J. F. H. Harper on his return to the Branch after service in the United Kingdom. Members were also reminded of the Annual General Meeting to take place in June.

Accessions to Branch Library

Publications received up to March 1951: *Radio and Electronics,* Vol. 5, No. 12 (February 1951); *Radio and Electronics,* Vol. 6, No. 1 (March 1951); Philips "Electronic Application Bulletin," Vol. 11, No. 8; Philips "Electronic Measuring," Vol. 3, No. 3; Philips Bulletin Jan./Feb., 1951; Philips "Radio Service—a Profit!" A book of over 100 pages giving a survey of test equipment designed for testing and servicing radio receivers. Main headings are:

(i) Use of the oscillograph in the service workshop.
(ii) Dynamic measuring methods.
(iii) Oscillators.
(iv) Generators.
(v) Universal and valve testing apparatus.

Philips Physiological Investigations with the Cathode Ray Oscillograph.

Philips "High Frequency Heating in the Woodworking Industry."

Philips "Generators for High Frequency Heating."
Philips "Theory and Practice of Strain Gauges."
Philips "Vibration Measuring Instruments."

(Continued on Page 48.)

TUBE DATA: Type 807 as an Audio Frequency Amplifier

Although the 807 is so popular as an audio frequency power amplifier, it is not always easy to find the relevant operating data for working it under specific conditions. We welcome this opportunity, therefore, of presenting complete data on the 807 as an audio amplifier, from Class A single-ended operation to push-pull Class AB[2] working, with useful power outputs from 6.5 watts to 120 watts. It is hoped that readers will find this very fully tabulated information as useful as we have found it ourselves.

The electrical characteristics of type 807 differ only slightly from those of type 6L6-G although, in the case of type 807, higher operating voltages are permitted. Type 807 may, therefore, be used to replace type 6L6-G in any circuit provided that the socket is changed to suit and provision made for the top-cap plate connection.

Heater[1], coated unipotential cathode.
Voltage, 6.3 A.C. or D.C. volts.
Current, 0.9 amp.
Transconductance (for Ib = 72 mA.), 6000 approx. μmhos.
Gri-screen Mu Factor, 8.
Direct Inter-electrode Capacitances (as tetrode)—
Grid to Plate (with external shielding), 0.2 max. μμf.
Input, 11 μμf.
Output, 7 μμf.
Maximum Overall Length, 5¾ in.
Maximum Seated Height, 5⅛ in.
Maximum Diameter, 2 1/16 in.
Bulb, ST-16.
Cap, small metal.
Base (Micanol), medium 5-pin.
Pin 1—Heater
Pin 2—Screen
Pin 3—Grid.
Pin 4—Cathode
Pin 5—Heater.
Cap, Plate.
Mounting position, any.

SINGLE VALVE AMPLIFIER—CLASS A1[2]

Plate	C.C.S.	I.C.A.S.	
D.C. Voltage	600 max.	750 max.	volts.
D.C. Screen Voltage	300 max.	300 max.	volts.
Plate Dissipation	25 max.	30 max.	watts.
Screen Dissipation	3.5 max.	3.5 max.	watts.

Typical Operation:	Fixed Bias.		Cathode Bias.		
Plate Voltage	385	250	275	375	volts
Screen Voltage	275	250	275	250	volts
Grid Voltage	—19.8	—	—	—	volts
Cathode Bias Resistance	—	176	162	200	ohms
Peak A-F Grid Volt	19.8	14	15.4	15.6	volts
Zero-Signal Plate Current	62	75	86	71	mA.
Maximum-Signal Plate Current	76	78	90	76	mA.
Zero-Signal Screen Current[3]	2.9	5.4	6.2	4.2	mA.
Maximum-Signal Screen Current[3]	8.1	7.2	8.3	6.4	mA.
Plate Resistance[4]	31,500	22,500	21,500	—	ohms
Transconductance[4]	5,450	6,000	6,300	—	umhos
Load Resistance	4,000	2,500	2,380	4,000	ohms
Total Harmonic Distortion	15	10	10	11	per cent
Maximum Signal Power Output	13.7	6.5	8.25	11.3	watts

AMPLIFIER—CLASS A1 (Triode Connection)

D.C. Plate Voltage	—	—	—	400 max	volts
D.C. Plate and Screen Dissipation (total)	—	—	—	25 max	watts
Typical Operation:					
Plate Voltage	250	300	350	400	volts
Grid Voltage	—	—	—	—	volts
Cathode Bias Resistor	400	446	472	620	ohms
Peak A.F. Grid Volts	20	25	30	37.5	volts
Zero-Signal Plate Current	47	54	61	58	mA.
Maximum-Signal Plate Current	50	56	63.5	60.5	mA.
Amplification Factor	8	8	8	8	
Transconductance[4]	5,050	5,500	5,400	5,300	umhos
Plate Resistance[4]	1,580	1,460	1,480	1,510	ohms
Load Resistance	3,000	4,500	4,500	6,000	ohms
Dominant harmonic	2nd	2nd	2nd	2nd	
Total Harmonic Distortion	5	5	5	5	per cent.
Maximum-Signal Power Output	1.6	2.2	3.3	4.2	watts

PUSH-PULL AMPLIFIER—CLASS A1

	C.C.S.	I.C.A.S.	
D.C. Plate Voltage	600 max.	750 max.	volts
D.C. Screen Voltage	300 max.	300 max.	volts.
Plate Dissipation	25 max.	30 max.	watts
Screen Dissipation	3.5 max.	3.5 max.	watts

Typical Operation: (Values are for two valves)

	Fixed Bias.			Cathode Bias.		
Plate Voltage	250	300	250	270	300	volts
Screen Voltage	250	300	250	270	300	volts
Grid Voltage[7]	— 16	—19.5	—	—	—	volts
Cathode Bias Resistor	—	—	125	125	119	ohms
Peak A.F. Volts (G-G)	32	39	35.6	40	44.5	volts
Zero-Signal Plate Current	120	157	120	134	157	mA.
Maximum-Signal Plate Current	140	182	130	145	170	mA.
Zero-Signal Screen Current	10	12.9	10	11	12.9	mA.
Maximum-Signal Screen Current	16	20	15	17	20	mA.
Effective Load Resistance (P-P)	5,000	4,750	5,000	5,000	4,750	ohms
Dominant Harmonic	3rd	3rd	3rd	3rd	3rd	
Total Harmonic Distortion	2	2	2	2	2	per cent.
Maximum-Signal Power Output	14.5	22.8	13.8	18.5	24	watts

PUSH-PULL AMPLIFIER—CLASS AB1

	C.C.S.	I.C.A.S.	
D.C. Plate Voltage	600 max.	750 max.	volts
D.C. Screen Voltage	300 max.	300 max.	volts
Maximum-Signal D.C. Plate Current	120 max.	120 max.	mA.
Maximum-Signal Plate Input	60 max.	90 max.	watts
Screen Input	3.5 max.	3.5 max.	watts
Plate Dissipation	25 max.	30 max.	watts

Typical Operation (Values for two valves)—

	Cathode Bias				Fixed Bias.		
Plate Voltage	400	400	400	400	500	600	volts
Screen Voltage	250	300	250	300	300	300	volts
D.C. Grid Voltage	—	—	—20	—25	—25	—27.5	volts
Self Bias Resistor	190	200	—	—	—	—	ohms
Peak A.F. Volts (G-G)	43.8	57	40	50	50	55	volts
Zero-Signal Plate Current	96	112	88	102	102	80	mA.
Maximum-Signal Plate Current	110	128	124	152	156	149	mA.
Zero-Signal Screen Current	4.6	7.0	4.0	6.0	6	4.7	mA.
Maximum-Signal Screen Current	10.8	16	12	17	17	16.5	mA.
Eff. Load Resistance (P-P)	8,500	6,600	8,500	6,600	8,600	10,600	ohms
Dominant Harmonic	3rd	3rd	3rd	3rd	3rd	3rd	
Total Harmonic Distortion	2	2	2	2	2	2	per cent.
Maximum-Signal Power Output	24	32	26.5	34	44	54	watts

A.F. POWER AMPLIFIER—CLASS AB2[5]

	C.C.S.	I.C.A.S.	
D.C. Plate Voltage	600 max.	750 max.	volts
D.C. Screen Voltage (Grid 2)	300 max.	300 max.	volts
Maximum Signal D.C. Plate Current[6]	120 max.	120 max.	mA.
Maximum-Signal Plate Input[6]	60 max.	90 max.	watts
Screen Input[6]	3.5 max.	3.5 max.	watts
Plate Dissipation[6]	25 max.	30 max.	watts

Typical Operation (unless otherwisespecified, values are for two valves)—

D.C. Plate Voltage	400	500	600	750	volts
D.C. Screen Voltage	300	300	300	300	volts
D.C. Grid Voltage (Fixed Bias Grid[2])	—25	—25	—30	—32	volts
Peak A.F. Volts (G-G)	78	78	78	92	volts
Zero-Signal Plate Current	102	102	60	60	mA.
Maximum-Signal Plate Current	240	240	200	240	mA.
Zero-Signal Screen Current	5	5	5	5	mA.
Maximum-Signal Screen Current	10	10	10	10	mA.
Load Resistance per Valve	800	1,060	1,600	1,740	ohms
Effective Load Resistance (P-P)	3,200	4,240	6,400	6,950	ohms
Peak Grid Input Power (approx.)[8]	0.2	0.2	0.1	0.2	watt
Maximum-Signal Power Output[9]	55	75	80	120	watts

[1]In circuits where the cathode is not directly connected to the heater, the potential difference should not exceed 100 volts. Under the maximum plate and screen dissipation conditions, the heater voltage should not fluctuate so that it exceeds 7.0 volts.

[2]Subscript 1 indicates that grid current does not flow during any part of the input cycle.
[3]Nominal value; subject to variation from valve to valve.

[4]At plate current corresponding to maximum signal (for cathode bias).
[5]Subscript 2 indicates that grid current flows during some part of the input cycle.
[6]Averaged over any audio-frequency cycle of sine wave form.

[7]The type of input coupling used should not introduce too much resistance in the grid circuit. When the grid circuit has a resistance not higher than 0.1 megohm, fixed bias may be used.

[8]Driver stage should be capable of supplying the grids of the class AB2 stage with the specified peak values at low distortion. The effective resistance per grid circuit of the class AB2 stage should be kept below 500 ohms and the effective impedance at the highest desired response frequency should not exceed 700 ohms.
[9]With zero-impedance driver and perfect regulation, plate-circuit distortion does not exceed 2 per cent. In practice, plate-voltage regulation, screen-voltage regulation, and grid-bias regulation, should not be greater than 5 per cent., 5 per cent., and 3 per cent. respectively.

GEOPHYSICAL RESEARCH

The Public Service Commission has announced the appointment of Dr. E. I. Robertson to the position of Director of the newly-created Geophysics Division within the Department of Scientific and Industrial Research.

Dr. Robertson was educated at the Hutt Valley High School and Victoria University College where he obtained his M.Sc. degree with first class honours in mathematics and was awarded a Shirtcliffe Scholarship. He served as a lieutenant in the Royal New Zealand Navy during the last war and on the cessation of hostilities went to the University of London and completed his Ph.D. in geophysics. On his return to New Zealand in 1947 he joined the Geophysical Section of the Geological Survey.

The new Geophysics Division aims to co-ordinate the work of the various New Zealand observatories dealing with seismology, magnetics, oceanography, and the ionized layers of the upper atmosphere, as well as the geophysical survey.

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SPECIFICATION — Snap Action. Balanced movement. Weight—2 ozs. approximately. Overall size—2″ × ¾″ × 1.″ Contact rating—5 amps. at 250 v. A.C. High Contact pressures. Proof against ordinary vibration. Internal Override Spring incorporated. Sealed against petrol, oil, dirt, moisture, etc. Robust case. Short plunger requires depression of .020″ to operate. Long plunger requires depression of .060″ to operate. Numerous switching combinations available. Silver contacts.

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ELECTRONIC FILLING MACHINE FOR LIQUIDS

The chemical and pharmaceutical industries often require automatic means of dispensing liquids under the control of an unskilled operator but without loss of accuracy. The "Apis" electronic liquid filling machine, manufactured by a Middlesex, England, firm, fills liquids in volumes from half a millilitre upwards into ampoules, vials, and bottles. The filling medium is an electrically controlled automatic burette.

Control is effected by means of photocells. The bottom cell is fixed while the top cell is adjustable on a sliding member moving along the length of the burette. The meniscus of the liquid actuates the photocells, the volume between which is the amount ejected at each cycle. This cycle can be either continuous or single stroke operation according to need. The liquid control is arranged with the aid of stainless steel valves built into the burette but actuated magnetically from the outside.

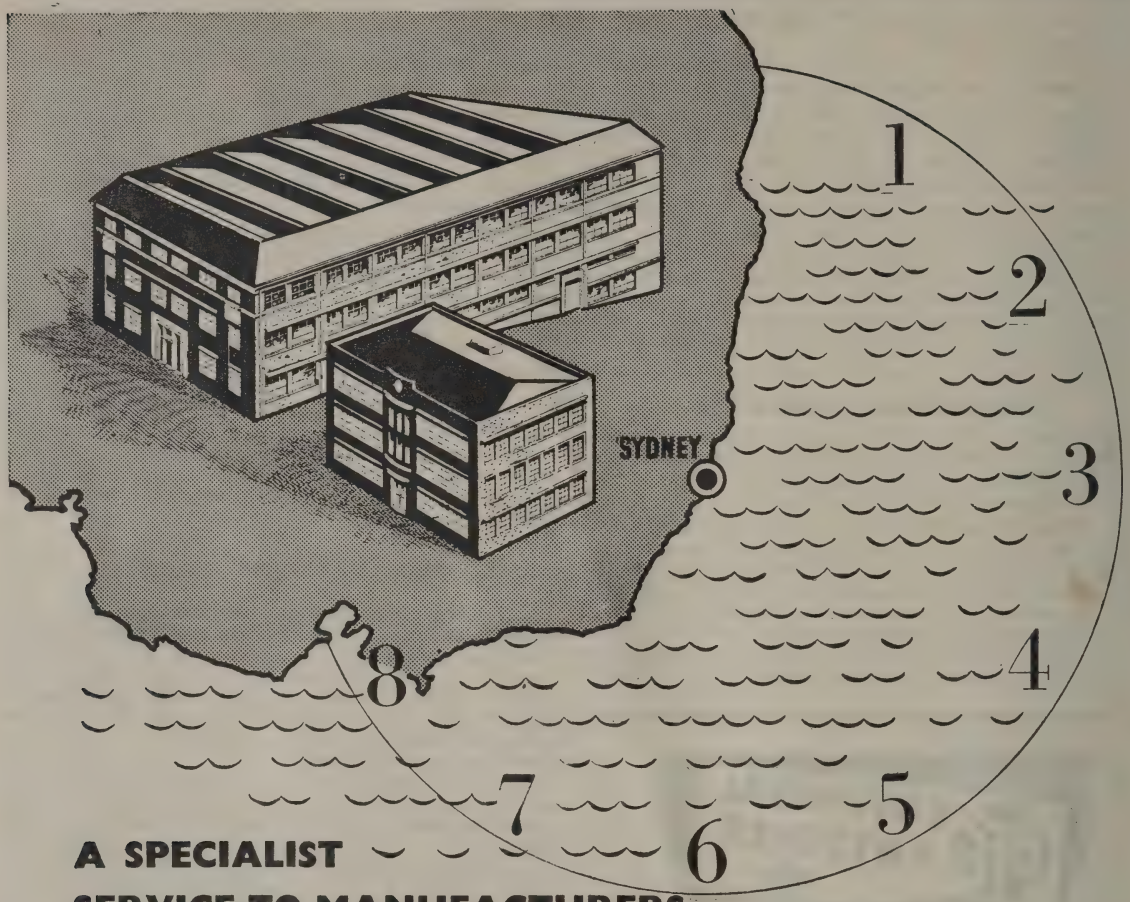
Accurate delivery and speed can be balanced to the user's requirements and once accurately set, the machine can be operated by unskilled labour. This accuracy will be indefinitely maintained.

NOVEL INTERNAL TELEPHONE SYSTEM USES MIDGET LOUDSPEAKER

An entirely new system for internal telephone communications has been developed by a London company. Originally designed for use in business premises, hotels, and other institutions, it can ensure complete privacy or can be used for loud speech when it is audible to a whole room.

Previously there has been a need for a communicating system which can be operated without hands. For instance, when a surgeon desires to give orders to his assistants or explanations to students without interrupting his work. The new system adequately performs this function.

A further use in hospitals is obtained by placing a central instrument in the sister's office, with small units so arranged that she can call the patients, and vice versa. Should a patient be seriously ill, the small unit can be so placed that the sister is able to listen to his breathing without actually going to the bedside.



A SPECIALIST SERVICE TO MANUFACTURERS . . .

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A number of New Zealand radio manufacturers have already taken advantage of the service and co-operation offered by Amalgamated Wireless Valve Company. A.W.V.'s Radiotron laboratories and technicians are anxious to help solve *your* manufacturing and designing problems. And this service is as close and as quick as the airmails can make it.

RADIOTRON NOTE:
Stocks are held in New Zealand of the latest Radiotrons: 6AR7GT, X61M, KT61. Samples will be supplied free to manufacturers. Write the sole N.Z. Distributors:

THE NATIONAL NEECO ELECTRICAL AND ENGINEERING COMPANY LIMITED
Auckland, Wellington, Christchurch, Dunedin, Hamilton, Wanganui, Hastings, Invercargill.

THE "RADIO AND ELECTRONICS" ABSTRACT SERVICE

AUDIO EQUIPMENT AND DESIGN

A new three-way loudspeaker developed by Jansen is said to establish a completely new standard of sound reproduction. The main bass speaker, operates to 600 cps approximately, the mid-frequency unit to about 4000 cps and there is a small tweeter with a normal response to 20,000 cps. The three units are mounted co-axially and a dividing frequency network is required.

—*Radio and Hobbies* (Aust.), April, 1951.

Many articles have been written on vented enclosures for the mounting of the loudspeaker, and the various designs require much digesting for the amateur. The article summarizes the technical information which has been published to date, and gives sufficient working for the home amateur.

—*Ibid*, p. 31.

Although long-playing records have only recently been offered for sale in Great Britain, the success of the venture is assured. The microgroove record has presented many problems for the manufacturer and the manner in which these problems have been met is described.

—*Wireless World* (Eng.), Jan. 1951 p. S. 7.

How many watts should your loudspeaker need, and should the amplifier be "flat?" Information is given of the power required for rooms of various sizes. Notes on peak limitation and transient responses are given.

—*Ibid*, p. 29.

The possibilities of the simple ladder filter are by no means exhausted by the classical filter theory. Any stray collection of components in ladder form is a filter, but to be of use there must be a central element and those elements coming before it must relate to input terminal resistance, and those following to the output terminal resistance. A simple mathematical treatment follows.

—*Ibid*, p. 31.

In a modulator for amplitude modulation an audio frequency and a higher frequency are combined, and an analogy is made to the case of magnetic recording with A.C. bias. The desired audio frequency and a much higher "bias" frequency are fed into a non-linear recording system. This "bias" technique provides greatly reduced harmonic distortion, as compared with D.C. bias or no bias.

—*Proceedings of the I.R.E.* (U.S.A.), February, 1951, p. 141.

The parabolic microphone is not by any means a handy device but a battery of beam-mounted microphones is sometimes out of the question and for many difficult jobs the parabolic microphone has many advantages. Practically any type of microphone pick-up can be mounted in a parabolic mirror on the lines given.

—*Audio Engineering* (U.S.A.), February 1951, p. 15.

The use of positive feed-back along with negative feed-back goes a long way towards correcting the deficiencies of a pentode amplifier. Further reduction of generator impedance and increased damping becomes possible, or in other words, the higher gain allows more negative feed-back to be utilized for a given reduction in overall gain. Details of such a design are given.

—*Ibid*, p. 17.

The scratch filter—a novel full circuit arrangement designed for use as such is described in conjunction with a wide range amplifier.

—*Ibid*, p. 20.

The theory of stereophonic sound—attention is concentrated on the limitations of our present "one-eared" reproducer system and the possibility of overcoming them. The objective is the production of more natural sound by adoption of stereophonic principles.

—*Wireless World* (Eng.), March 1951, p. 84.

The outstanding advance in magnetic recording is due largely to the introduction of higher coercivity materials such as magnetic iron oxide. A simple outline of the theory is given.

—*Ibid*, p. 88.

During the past decade, architects and consulting engineers have realized the necessity for incorporating electro-acoustic aids when halls are designed. The Assembly Hall at Church House, Westminster, has elaborate provisions for microphones and speakers to ensure perfect hearing for all concerned.

—*Ibid*, p. 117.

CIRCUITS AND CIRCUIT ELEMENTS

Stabilizing feed-back amplifiers. To add feed-back to existing amplifiers may not be an easy problem, and graphs are supplied to make the job as simple as possible.

—*Ibid*, p. 112.

ELECTRONIC DEVICES

Improved communications systems are predicted upon devices in which the time scale is expanded and compressed as well as upon delay types. Equipment for attaining these conditions, including electro-static storage tubes, delay lines, and flip-flop circuits, is described.

—*Electronics* (U.S.A.),, December 1950, p. 69.

Dielectric heaters—increased efficiency is accomplished when transmission lines coupling radio-frequency generators to loads in dielectric-heating applications are used as part of the load tuning system to simplify problems of load matching .

—*Ibid*, p. 99.

In many respects the requirements of harbour radar are more stringent than those of ship-borne radar, as the harbour authority must have a clear picture over a very wide area. A description is given of the new Decca radar, specially developed for this purpose.

—*Wireless World* (Eng.), March 1951, p. 105.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

How reliable is a radio valve? Notes are given of a discussion on the reliability of valves used for various applications, and the results seem to be pessimistic. The factors contributing to unreliability are mentioned.

—*Ibid*, p. 91.

A statistical evaluation of life expectancy of valves designed for long operation. As the industrial use of valves increases the lifetime of the device becomes more and more important. Statistical information is given of tests made and an equation is derived for the curve of life survival percentages.

—*Proceedings of the I.R.E.* (U.S.A.), February 1951, p. 137.

MATHEMATICS

The theory of the negative impedance converter. The paper presents a relatively new approach to the solution of negative impedance problems related to vacuum tube circuits. A vacuum tube circuit arranged to develop negative resistance will present reactance as well at some frequencies. The theory is related to a negative impedance repeater for use in exchange plants.

—*The Bell System Technical Journal* (U.S.A.), Jan. 1951, p. 88.

Combining sound levels. A nomogram dispenses with the need for log tables, decibel tables, or a slide rule when determining the total acoustical power resulting from the combination of two or more sounds.

—*Electronics* (U.S.A.), December 1950, p. 118.

Vector diagrams. The paper is the continuation of earlier articles on some of the misunderstandings connected with vectors and deals with them in relation to the valve in operation.

—*Wireless World* (Eng.), March 1951, p. 95.

MEASUREMENTS AND TEST GEAR

Special precautions are necessary when testing steep-slope valves in the usual testing equipment. The multiple electrode leads in such an instrument are capable of setting up parasitic oscillations which make the test very inaccurate.

—*Ibid*, p. 108.

The author describes a circuit designed for comparing phase angle measurements between two sinusiodal signals of the same frequency. Angles from 60 to 90 degrees can be measured directly but with decreasing accuracy.

—*The Post Office Electrical Engineers Journal* (Eng.), January 1951, p. 198.

Prospectors for radioactive ore need only a rough indication to locate it, and a light-weight detector by Ekco weighs little more than three pounds. It uses a halogen-quenched G-M tube.

—*Wireless World* (Eng.), January 1951, p. S. 6.

An electronic lightning calculator for the amateur is about the most useful piece of apapratus he can have. It combines the features of a general-purpose signal generator and other instruments and will enable the estimation of components for L-C circuits or give the values of components quickly.

—*QST* (U.S.A.), March 1951, p. 17.

From a CRT with a two-inch screen can be made a most useful instrument for the measurements of parameters. A design is given for the making of the instrument of the "Miniscope" type.

—*QST* (U.S.A.), February 1951, p. 17.

PROPAGATION

Atmospheric review for 1950. During 1950 the sunspot cycle continued in the "declining phase" and the rate of decrease in activity was greater than in any year since the maximum in 1947. Some interesting phenomenon occurring during the year are mentioned, with a forecast for 1951.

—*Wireless World* (Eng.), March 1951, p. 111.

The author relates an investigation of vertical incidence ionosphere absorption at 150 kc/sec., a part of the spectrum where the problem has received scant attention. The existence of relationship between the variation of the absorption and the sun's

(Continued on Page 48.)

FOR THE SERVICEMAN: ZENITH

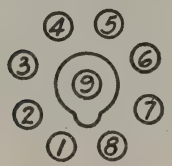
MODELS

5-S-119, 5-S-126, 5-S-127, 5-S-150, 5-S-151, 5-S-161

CHASSIS No. 5516

SOCKET VOLTAGES

Tube	Position	1	2	3	4	5	6	7	8	9
6A8	1st Det. Osc.	0	0	240	85	–1	166	6ac	4	0
6K7	I. F.	0	0	240	85	3	—	6ac	3	0
6Q7	2nd Det. A.V.C.	0	0	75	.1	.1	—	6ac	1.5	0
6F6	Power	0	0	230	240	–5	—	6ac	0	—
5Y3 5W4	Rectifier	0	240	—	AC	—	AC	—	240	—



BOTTOM VIEW OF SOCKET

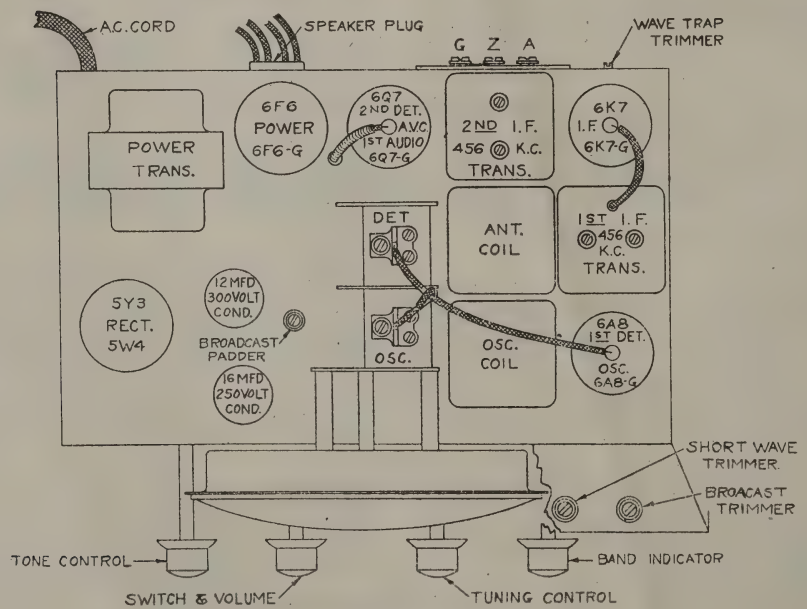
All voltages measured from point indicated to ground, using a 1000 ohm per volt meter with antenna and ground disconnected.

Line Voltage 112V.

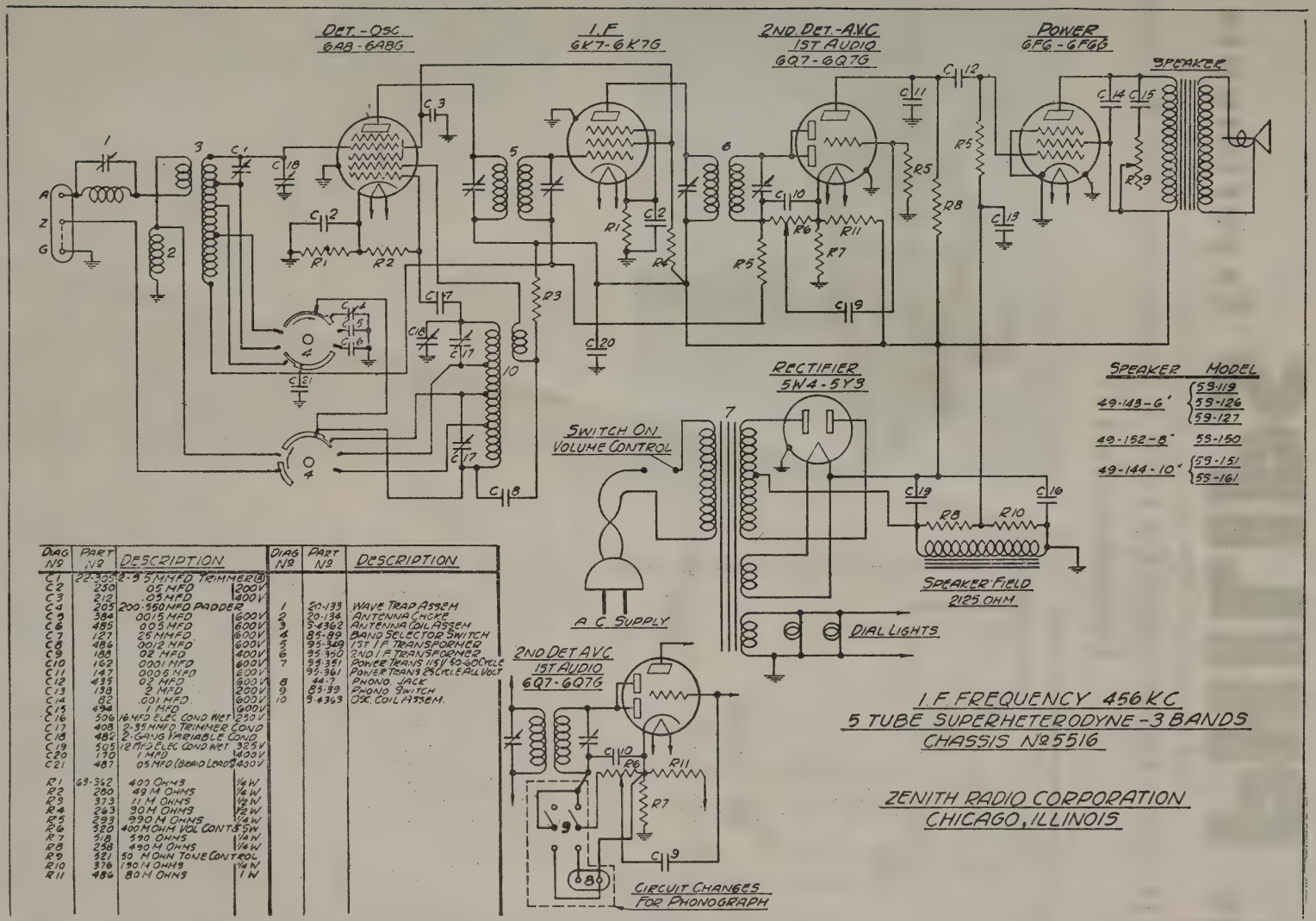
Current Consumption 55 watts.

Power Output 3 watts.

Alignment Procedure on page 26.



TUBE POSITION



DIAG Nº	PART Nº	DESCRIPTION		DIAG Nº	PART Nº	DESCRIPTION
C1	22-305	2-9.5 MMFD TRIMMER	ⓐ			
C2	230	.05 MFD	200V			
C3	212	.03 MFD	400V			
C4	205	200-550 MFD PADDER		1	20-133	WAVE TRAP ASSEM
C5	384	.0015 MFD	600V	2	20-134	ANTENNA CHOKE
C6	485	.005 MFD	600V	3	5-4362	ANTENNA COIL ASSEM
C7	127	25 MMFD	600V	4	85-89	BAND SELECTOR SWITCH
C8	486	.002 MFD	600V	5	95-349	1ST I.F. TRANSFORMER
C9	188	.02 MFD	400V	6	95-350	2ND I.F. TRANSFORMER
C10	162	.0001 MFD	400V	7	99-351	POWER TRANS 115V 50-60 CYCLE
C11	147	.0005 MFD	600V		95-361	POWER TRANS 25 CYCLE ALL VOLT
C12	435	.02 MFD	600V	8	44-7	PHONO. JACK
C13	139	.2 MFD	200V	9	83-39	PHONO. SWITCH
C14	.02	.001 MFD	600V	10	5-4363	OSC. COIL ASSEM.
C15	494	1 MFD	400V			
C16	506	16 MFD ELEC COND WET	250V			
C17	408	2-35 MFD TRIMMER COND				
C18	482	2-GANG VARIABLE COND				
C19	505	12 MFD ELEC COND WET	325V			
C20	170	1 MFD	400V			
C21	487	.05 MFD (BRAID LEAD)	400V			
R1	69-342	400 OHMS	½W			
R2	280	49 M OHMS	½W			
R3	373	1 M OHMS	½W			
R4	243	90 M OHMS	½W			
R5	293	990 M OHMS	½W			
R6	320	400 M OHM VOL CONTROL	SW			
R7	518	590 OHMS	½W			
R8	258	490 M OHMS	½W			
R9	321	50 M OHM TONE CONTROL				
R10	376	190 M OHMS	½W			
R11	486	80 M OHMS	1W			

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CIRCUIT DIAGRAM—Models 5-S-119, 5-S-126, 5-S-127, 5-S-150, 5-S-151, 5-S-161. (Chassis No. 5516)

The PHILIPS Experimenter

An Advertisement of Philips Electrical Industries of N.Z. Ltd.

No. 44: Some Philips Tubes for U.H.F. Communication and Measuring Equipment—Part II

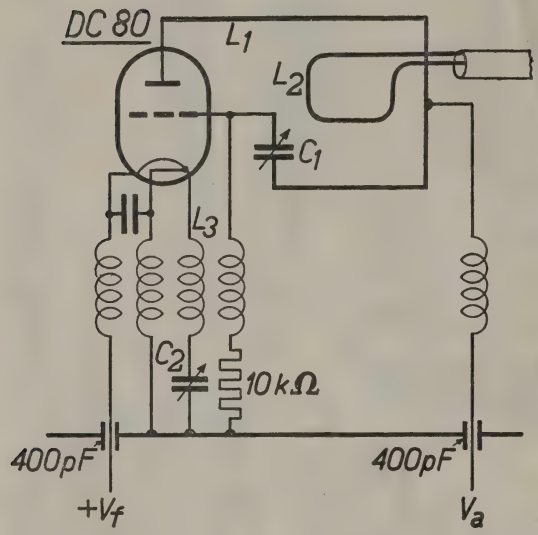

Fig. 1

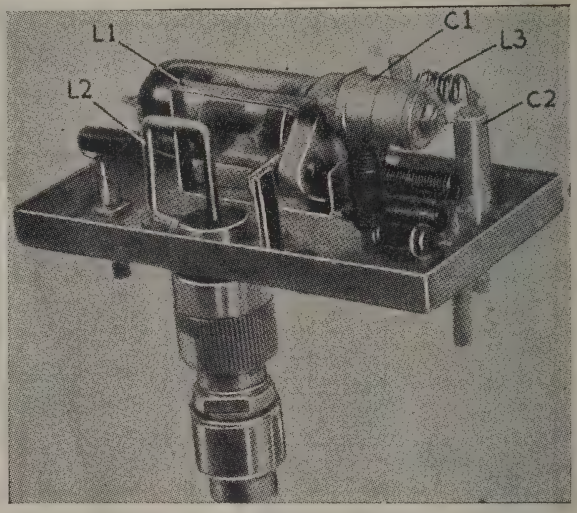

Fig. 2

Part I of this article described the design and characteristics of the DC80, EC80, EC81, and EC55, all of which are new Philips valves specially designed for use at much higher frequencies than valves of conventional construction usually can be made to work. In this instalment, we describe some examples of actual equipment in which these Philips valves perform, and while it is not possible in the small space available to give very complete constructional details, it is not thought that this will be a great disadvantage to those who may wish to put these interesting tubes to work.

A SIMPLE U.H.F. OSCILLATOR FOR BATTERY SUPPLY

In Figs. 1 and 2 are shown the circuit diagram and a photograph respectively of a small and compact oscillator, of simple construction, which acn be used very successfully in the range around 450 mc/sec. It uses a Philips DC80, and in spite of the high frequency, there is nothing about its construction that cannot be done even with the most primitive workshop facilities. As with most U.H.F. oscillator circuits, this one is yet another variation of the well-known Colpitts oscillator. The inter-electrode capacities of the valve, from plate to cathode and from grid to cathode, form the capacitative voltage divider that is an essential feature of the Colpitts circuit, and are none the less real in spite of the fact that they do not show on the circuit diagram. The Philips trimmer condenser, C_1, acts both as a tuning element in the R.F. circuit, and as a blocking condenser to prevent the H.T. voltage from being applied to the grid of the tube. The three filament leads, which also represent the cathode, since the valve is a directly-heated one, are each provided with an R.F. choke. This has the effect of allowing the cathode to take up any R.F. potential it may wish, and so ensures that the oscillation feedback actually obtained by virtue of the inter-electrode cpaacities is not modified in any way by an only partially successful attempt at grounding the filament circuit. The latter course is virtually impossible at the frequencies with which the circuit is dealing, so that allowing the filament circuit to "float" in this way is a trick which ensures that the valve oscillates as efficiently as possible. The condenser, C_2, which can also be a Philips trimmer, enables some control to be obtained over the voltage taken up by the cathode, and it will be found that there is an optimum setting of this condenser for each operating frequency. The condenser C_1 acts as the main tuning condenser, but C_2 will have an effect on the oscillation frequency too, so that if it is desired to obtain the most efficient operation at a particular frequency, it will be found necessary to adjust C_1 and C_2 in succession until the most lively operation is obtained as well as the required frequency. In achieving this, it will be helpful to insert a milliammeter in the earthy end of the 10k. grid leak resistor, since the best oscillation will be indicated as the greatest grid current for a given frequency. The procedure will be somewhat as follows. C_1 is adjusted to give the required frequency, as judged by Lecher wires or some other simple frequency meter, and

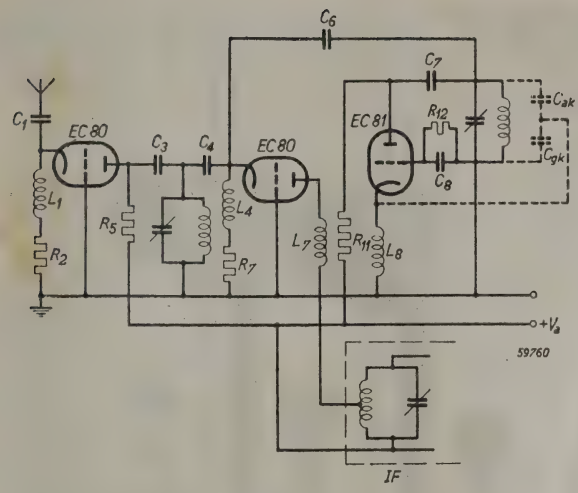

Fig. 3

of this loop, while alteration of coupling to the co-axial output line can be effected by rotating the coupling loop about the centre of the co-axial connecter.

H.F. SECTION OF A RECEIVER FOR 300–400 MC/SEC. WITH THE TUBES EC80, EC80, AND EC81

In Figs. 3, 4, and 5 is illustrated the H.F. section of a receiver which is suitable for continuous tuning between the above-mentioned frequencies. Fig. 3 shows the circuit diagram in its conventional form, while the circuit of Fig. 4 gives a semi-diagrammatic representation of hte actual physical circuit. It is not possible in the available space to give a complete and comprehensive description of this arrangement, but the diagrams themselves will be very useful in illustrating the relatively slight departure from conventional circuitry that enables these valves to function at the relatively high frequencies involved. The first EC80 acts as a grounded-grid R.F. amplifier, the second EC80 as a grounded-grid mixer, and the EC81 as the local oscillator. At radio frequency, it will be noted that only two tuned circuits are used, and that these both employ co-axial lines rather than the conventional LC tuned circuits shown on Fig. 3. L_1, in

COMPONENT LIST

R_2, R_7, 100 ohms.
R_5, R_{11}, 1000 ohms.
R_{12}, 10k.
C_1, C_2, C_3, C_5, C_7, 100 $\mu\mu$f.
C_4, 5.6 $\mu\mu$f.
C_6, 2 $\mu\mu$f.
C_8, 56 $\mu\mu$f.

Note.—The intermediate frequency can be chosen to suit the remainder of the receiver, since the oscillator frequency range is rfom approximately 300 to 400 mc/sec., and is adjustable separately from the signal frequency circuits.

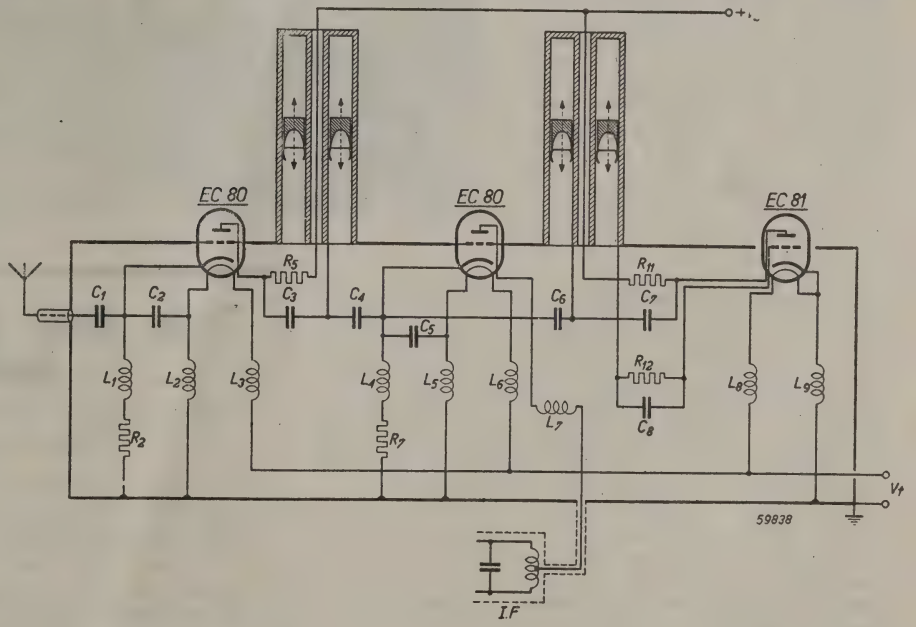

Fig. 4

the grid current is noted. C_2 is then adjusted in order to find which direction it needs to be moved in, in order to increase the grid current. This done, an arbitrary adjustment is made in the direction indicated, and C_1 is re-adjusted to bring the frequency back to the desired figure. This process might have to be repeated several times in order to realize the best possible operating conditions. It should be noted that the filament has been paralleled by a condenser in order to avoid any R.F. voltage drop across it. The R.F. chokes consist of 20 turns of fairly heavy wire (say 20 gauge) self-supporting, and wound on a $\frac{1}{4}$ in. diameter former.

The tuned "winding" L_1 is made from a strip of copper sheet approximately half an inch wide, and bent as shown in the photograph. It is a simple matter to alter the frequency range of the oscillator by varying the size

the cathode circuit of the R.F. amplifier tube is an R.F. choke, used solely to prevent the stray capacity associated with R_2, the cathode bias resistor, from acting as a shunt on the R.F. voltage appearing at the cathode. The omission of a tuned circuit from this position does not entail any significant loss of signal voltage, on account of the very low impedance of the cathode input terminal. This low impedance would damp any tuned circuit so heavily that however higher its unloaded Q might be, no useful selectivity or signal amplification would result. The input circuit can be tuned in practice by selecting the correct length for the co-axial input lead, so that its reactance is inductive, and resonates with the input capacity of the first valve. When this length is correctly

adjusted, there will be maximum power transfer from the aerial to the first valve.

Apart from the input arrangements, the main points of difference between the circuits of Figs. 3 and 4 are to be found in the insertion of R.F. chokes in all filament leads, and in the use of the co-axial lines as tuned circuits. It might be thought that the low input impedance of the mixer valve would again damp the previous tuned circuit so heavily that no amplification worth mentioning would take place, but here again the mere appearance of the circuit diagram does not tell the full story. The value of the C_4 is chosen in practice so that together with the input capacity of the mixer valve's cathode circuit, it forms a capacitative voltage divider. The cathode of the mixer is connected at the tap on this divider, and by suitably choosing C_4, it can be arranged that the cathode is "tapped down" the tuned circuit until an impedance match is obtained between it and the input resistance of the valve.

The second co-axial line is the tuned circuit for the oscillator valve, and injection is accomplished through the condenser C_8. All the R.F. chokes in Fig. 4 are made by winding approximately 10 inches of 20-gauge wire on a quarter-inch former. The diameter is not critical, as long as the total length of wire used remains as specified.

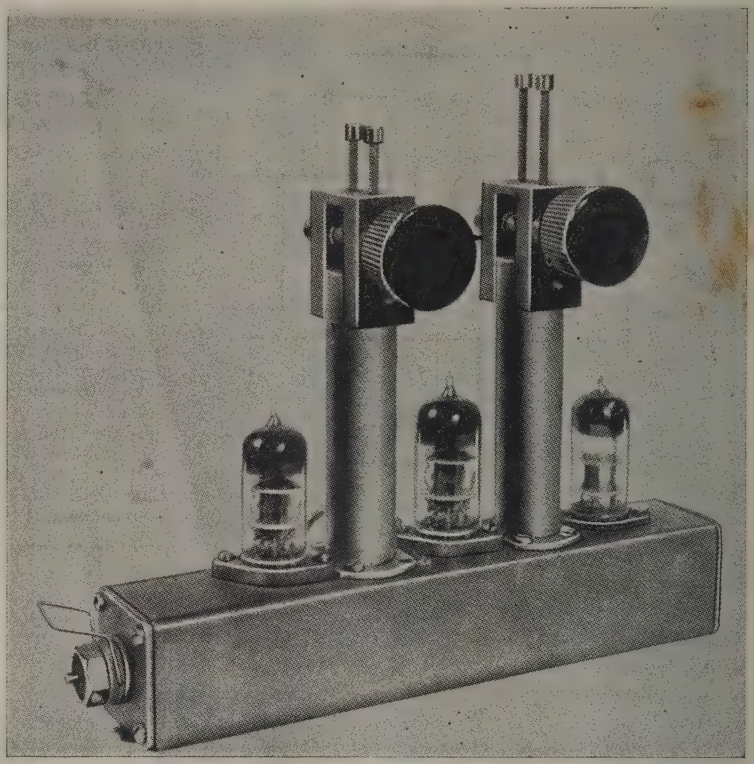

Fig. 5

Fig. 5 shows a photograph of the completed "front end." Adjustment of the tuned circuits is made by means of a rack and pinion gear operating the short-circuiting plungers in each line. This form of tuned circuit is very stable, and it has been found that the frequency drift of the oscillator during its warm-up period is no more than 50 kc/sec. With the circuit values shown, the bandwidth of the circuit is about 5 mc/sec.—sufficient for many purposes such as radar receivers or television receivers, where great bandwidth is a necessity.

The above two examples serve to show how readily frequencies above 300 mc/sec. can be handled by the use of these new Philips tubes, and that they fill a very real requirement in bridging the gap between those frequencies where ordinary LC circuits still function satisfactorily, and those where full-scale microwave technique must be employed.

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"The time has come," the Walrus said,
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THIS TELEVISION BUSINESS

All the talk of recent months in radio circles has been largely centred about the possibility of television being introduced into New Zealand in the not-too-distant future.

The pace has quickened somewhat just lately with the visit to our shores of a leading British television representative, and still more recently by an actual demonstration of this most modern form of entertainment.

The much-travelled gentry who had seen television in other countries had a basis for comparison and were able to let down their hair and talk knowingly upon the subject; others, like the writer, were seeing it for the first time and forming their own impressions.

Now the first thought that must have occurred to most people going to see the presentation was how the display would compare with the cinema form of reproduction to which we have become accustomed, and whether it was good enough to justify the necessary expendiutre involved in order to introduce to the New Zealand public. It appears now that reproduction may not be up to movie standard, but is, nevertheless, satisfactory. As to the advisability of whether New Zealand should inaugurate a system the answer must be overwhelmingly "Yes!"

That the entertainment value of television will be great is obvious and its impact upon the people will be far greater than radio ever was, since it will command a person's whole attention and become eventually a centre of family life. To those stout souls who are rearing a family in this troubled age and find it so difficult to get out in the evening for entertainment, this new art is going to come as a real boon. True, there are some pessimistic types who say it is not stimulating to thought and that it is the lazy man's method of entertainment since he just has to "sit, look, and listen." This line of reasoning however seems dangerously like inviting an argument, for surely entertainment should provide relaxament. Most radio men will agree that they get all the thought stimulation they require during the course of a normal business day without carrying it over into the evening! Anyway, if we are to believe medical science, modern man is in no danger of becoming a moron, rather the reverse, in fact, since his capacity for thought is increasing with every generation, and with all these distractions abounding!

Needless to say one of the greatest bones of contention concerning television is this question of number of lines to the picture. At present every country in the world seems to have its own idea about this, and choices range from 405 to some eight hundred odd! At first thought it would seem that the more lines to the picture the better the detail and definition one should get. In practice this doesn't work out quite so smoothly for a variety of reasons, and in fact the British system on 405 lines seems to be winning hands down where picture quality is concerned. In the first case, with increased numbers of lines to the picture transmission difficulties are increased and receiver design becomes necessarily more complicated. To illustrate this point further it should be understood that good clear pictures are dependent to a very large extent on the capabilities of the video amplifiers employed. These must be wide-band amplifiers in the fullest sense of the word and by wide-band we do not mean the usual fifteen to twenty thousand cycle top limit, but something like six, seven, or even eight megacycles! Most radio men who have had experience with audio amplifiers will appreciate the difficulties involved in passing a square wave through an amplifier and achieving something in the output stage which looks a reasonable representation of the original. The square waveform if it is of good steep fronted shape, is theoretically composed of extremely high frequencies and so it is with television. Sudden transitions from black to white and vice versa can make great demands on an amplifier similar in respect to our square waveform. Failure to conform in this essential can only lead to poor definition and lack of good resolution in the picture. This problem is increased by introducing a greater number of lines to the picture since the amplifiers are called upon to reproduce even higher frequencies owing to the greater rate of scanning since the two are synchronized.

Possibly the authorities in New Zealand are concerned about this choice of number of lines to adopt as a standard here, particularly with all this argument going on overseas concerning colour television. However, it does seem that colour transmission will be either fully compatible—that is, capable of being received in monochrome by receiving sets not adapted for colour, and therefore able to be employed by any system irrespective of the number of lines chosen—or otherwise it will be developed as a separate system over and above standard transmissions for those people prepared to pay the extra in order to have colour presentations.

To this end it would seem to the writer to be good policy to follow the British pattern of television, knowing that we out here in New Zealand could follow in their footsteps and reap the benefit of their research into the subject, for obviously the B.B.C. will not go ahead with any wild scheme involving the public in great expenditure just for mere novelty.

Whichever way it goes, however, one thing is certain —while hundreds of people are obtaining considerable enjoyment from it the radio servicemen will be getting bags of thought stimulation while burning the midnight oil trying to fix Mrs. So-and-So's set in time for the cooking demonstration next morning!

●

VIBRATORS

Having thrashed all the foregoing out we can now turn towards vibrators or away from them as your fancy dictates. Here we find practically the same set of circumstances as for hum and all the previous information on this topic should be well heeded. However, one prolific source of hash is filament or heater induced noise, caused by pulsations of vibrator noise being fed through the filaments of the valves and amplified by them; so good filtering of the heater supply is very necessary. The writer has found a few turns of heavy gauge wire wound on an old speaker transformer core to be very useful in this respect and will frequently kill noise like magic. Adequate bypassing of the heaters is also very effective but condensers need to be of high capacity to really work well, something like 50 μf. or more and also try earthing the condenser in various points about the chassis to find the best position. Generally it is critical.

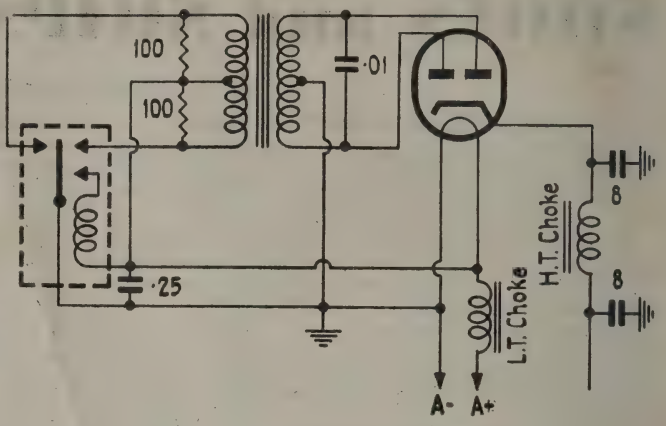
In so far as the vibrator power supply itself is concerned it is by far the better idea to construct it on a separate chassis distinct from that of the radio or amplifier. This isolates odd stray circulating currents in the chassis and is a number one weapon against noise.

To the person who is using vibrators for the first time, and to others also, it is strongly recommended that the separate power supply unit be employed. It will save an awful lot of headaches in the long run.

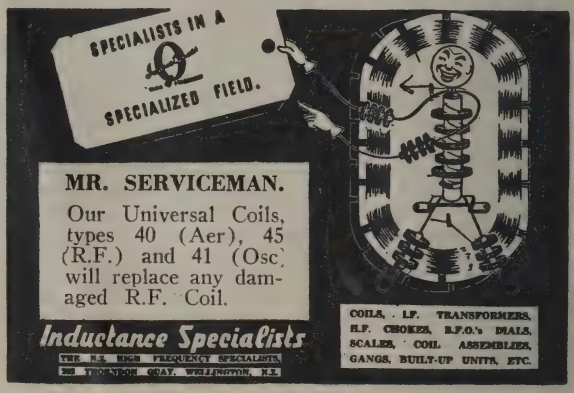
Across the vibrator transformer primary from centre tap to either side, two low-value resistors should be connected. These serve to reduce sparking at the contacts and also damp out unwanted oscillatory currents in the transformer primary. In most cases they are generally more effective than condensers in removing vibrator hash. If the energizing coil for the vibrator reed is brought out to a separate pin this also will require bypassing with at least a 0.25 μf. condenser. Wherever it is at all possible, endeavour to use one point only for an earth and return to that point everything associated with the power supply.

In radio sets having good R.F. sensitivity it is sometimes most difficult to prevent hash being picked up through the aerial lead, but very often a good earth and a good aerial will overcome this. However, one cannot always rely on the set being operated under these conditions, so a piece of shielding braid put over the short aerial lead from the set itself will work wonders. Then again the battery leads from the power supply can, and generally do, radiate noise with wild abandon. Metallic shielding braid slipped over these two leads and earthed at the chassis is usually sufficent to prevent this trouble.

The diagram shows a vibrator supply with normally sufficient filtering, although it is realized that to suit particular conditions some modifications may be necessary. In other words, do everything we have said; if it's still not right don't blame us—that's the way it is with vibrators!



A typical vibrator supply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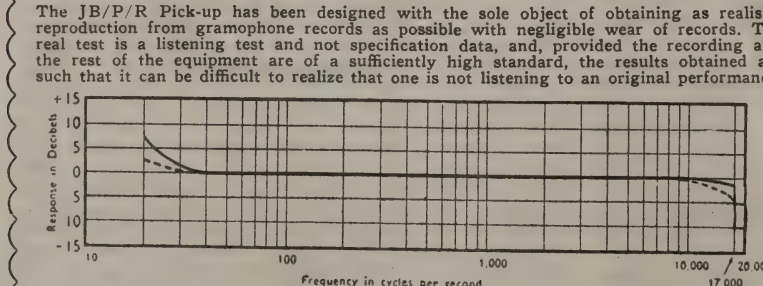

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Specification of Brierley Ribbon

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Magnet Alloy: Alcomax.
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No measurable upper resonance.
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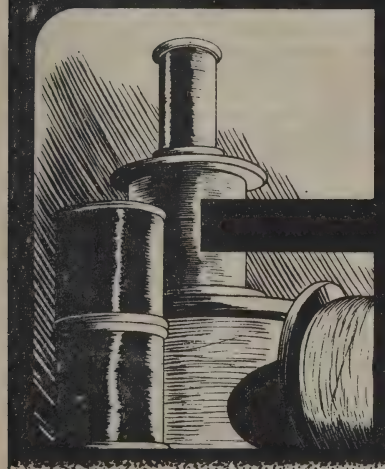

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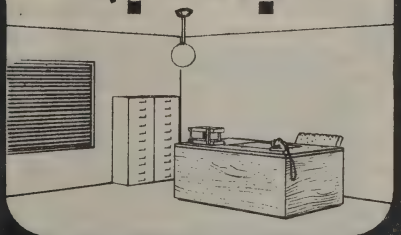

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New Zealand Radio Traders' Federation

ELECTION OF OFFICERS

Resulting from the Annual Meeting held in April 1951, the following were elected for the incoming year:—

President: Mr. J. Fairclough, re-elected.

Vice-President: Mr. D. B. Billing.

Executive Members: Mr. G. J. Markby, Immediate Past-President; Mr. M. M. Gillick, Otago Association; Mr. E. B. Borham, North Island Minor Associations; Mr. A. K. Griffiths, South Island Minor Associations.

Auditor: Mr. B. Y. Berry.

Four members yet to be elected from the Auckland, Wellington, Canterbury, and Southland Associations respectively.

J. Fairclough

Unanimously elected to continue the presidency for another year, radio traders are fortunate in having a man of his sterling capabilities and untiring energy as has been shown by Mr. J. Fairclough for many years. Commencing in the radio business in 1928, he has seen much of the problems of the trade and he has always responded readily to demands upon his time as an executive of the Federation and during the past twelve months as President he has travelled extensively to Wellington and other parts on Federation affairs. John Fairclough gives also of his time liberally to Napier Retailers' Association and the Hawke's Bay Automobile Association besides being prominent in football and other recreational activities, proving the oft quoted "get the busy man for the job." As a chairman, he fills the part with great efficiency, having the knack of controlling awkward moments with dignity and great foresight which could be the envy of many. This journal offers its congratulations to John Fairclough on his re-appointment.

●

Our congratulations go to D. B. Billing (Dud) on his appointment as Vice-President for the coming year. Such appointment will, we are sure, be accepted with much appreciation by all who know him. Of popular

Mr. D. B. Billing

personality, quiet and unassuming, Dud has for many years worked hard for the radio industry in Federation affairs. His highly skilled technical knowledge combined with sound administrative ability of which he has given freely and generously to trade problems has already been of inestimable value. In recent months he has steered the course of delegates of the Federation on such important questions as Import and Licensing, Workers' Awards, etc. A background of hard-working experience goes with this new Vice-President; commencing in the fairly early days of radio under the experienced eye of his brother Preston, Dud later joining the staff of F. J. Penny, Ltd. (now non-existent) which concern enjoyed a good retail radio business in Willis Stret, Wellington. From there he transferred to Todd Motors, Ltd., but soon after found his basis for greater development in radio at Turnbull and Jones, Ltd., with whom he has been for the past 16 years and holds the position as Radio Manager, H.O. staff. During the war he served in several spheres of home activity, but mainly in the Signal Wing of Army School, Trentham, and held the position of Chief Technical Instructor. Enlisted as a private he rose in the normal stages to rank of captain.

Whilst radio is also a hobby of his, Dud believes in variety and finds much relaxation with the Royal Choral Union where he finds scope for his pleasing baritone voice, and during the summer he plays cricket for Miramar A, and last year skippered this team. He is also a member of the management committee of the Mercantile Cricket League and he proudly holds a cap and blazer for representative matches.

That the President will have an able lieutenant in Mr. D. B. Billing goes without saying and the Federation is fortunate to have these two leaders for the coming year.

PYE SHOW THE POSSIBILITIES OF SPONSORED TV

The Pye Company recently gave a most successful television demonstration to members of the Institute of Incorporated Practitioners in Advertising (the controlling body of the Advertising Profession), to show the possibilities of sponsored television. This show was unique in nature and completely unlike any television demonstration previously given by that company or any other. It was, in fact, the first demonstration of its kind to be given in Great Britain.

This enterprising demonstration was given because the demonstrators, as a company, know the dangers of a monopoly, and because they believe that competition achieves the best results. They felt that television needs big-name stars, and the aim of this demonstration was to show that sponsored television—not at present allowed in England—would not only be a practical and economical means of advertising, but would also be a highly satisfactory form of entertainment. The programme was arranged with the help of some of the leading radio and television stars and consisted of a variety show interspersed with advertising announcements.

Electronics in the Festival

By GEOFFREY W. HART, M.A., A.M.I.E.E.

Electronic engineers will find much to interest them in the Festival of Britain, which will be held from 3rd May to 30th September of this year. Apart from the opportunity to visit radio, TV, and other installations in Britain, they will be offered a comprehensive review of British industrial and research developments in several exhibitions, notably the South Bank Exhibition in London.

This Exhibition, planned in the best contemporary style by a team of young architects and designers, sets out to display those aspects of modern civilization which owe most to British initiative. Each building will be devoted to one aspect of life, for example agriculture, transport, communications, the home, sport, and so on.

One interesting building will be the "telecinema," a novel structure designed by the well-known architect, Wells Coats. Seating 400, it will demonstrate all the most promising of recent developments, including full-size projected TV pictures, stereoscopic films in colour with four-channel sound on magnetic tape, a high efficiency screen, and special lighting techniques. The purpose of installing this complex equipment is to conduct a full-scale pilot experiment which, it is hoped, will reveal the possibilities of these new techniques of public entertainment. During the five months of the Festival the reactions of visitors will be noted, providing useful data for those in the cinema industry who are seriously concerned with its future prosperity.

Experiment is also the keynote of the radio astronomy exhibits. There will be demonstrations of cosmic radio noise and meteor echoes and an attempt will be made to bounce high-power pulses off the moon from a 120 megacycle transmitter with a remotely controlled aerial on the site. When conditions are favourable it may be possible for these echoes to be received in distant countries, such as the United States.

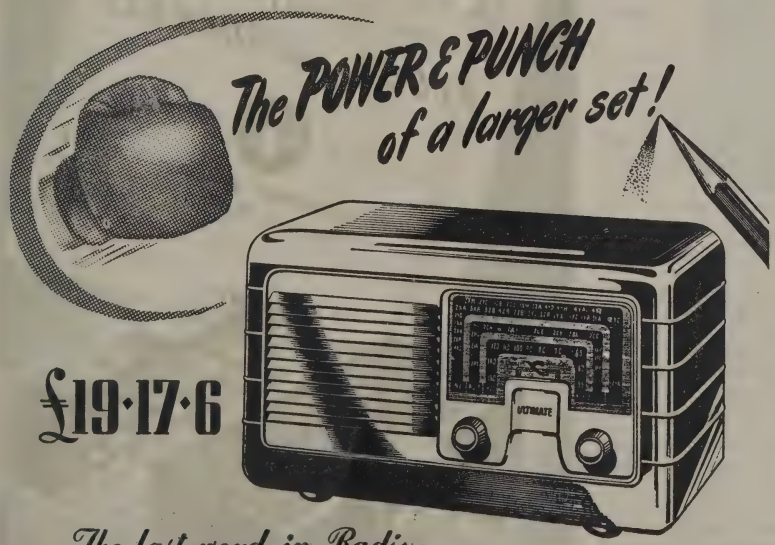
Radar equipment of a more orthodox kind will be demonstrated in the pavilion which deals with transport and communications. A 12 ft. (3.66 metres) scanner, radiating 0.1 micro-second pulses in the three centimetre band, will provide a brilliant picture on the Plan Position Indicator of a famous stretch of the Thames lying between the Houses of Parliament and St. Paul's Cathedral. Viewers will be able to track by radar the Festival river launches plying between the South Bank piers and the Festival Gardens in Battersea Park.

The story of the British contribution to transport and communications will be told in a building large enough to accommodate full-size railway locomotives, road vehicles, and aircraft. That section which deals with communications techniques has been carefully planned to link up at appropriate points with the adjoining transport sections. For instance, mails link with railways, mobile radio with roads, and radio aids with sea and air.

Included in this display will be interesting exhibits and demonstrations, ranging from an illuminated working

In every point - PERFECTION!

The POWER & PUNCH of a larger set!



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ULTIMATE

Manufactured by—
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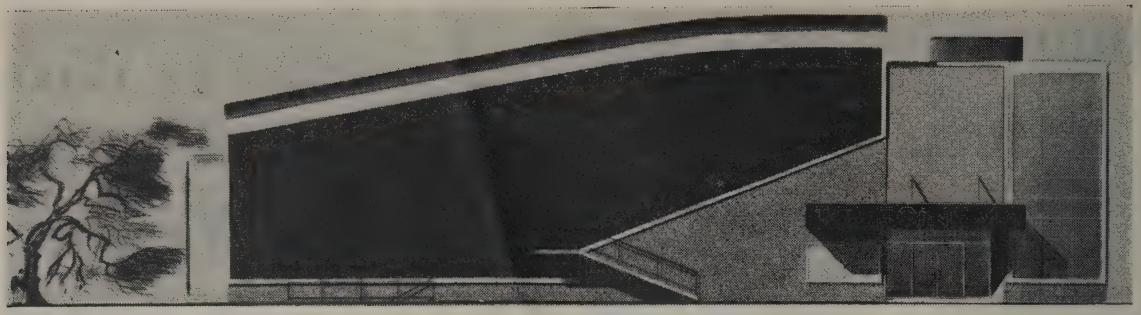


An artist's impression of the Telecinema, specially designed to show both films and large-screen television.

diagram which will show the electron paths and high frequency currents inside a cavity magnetron, to the latest picture telegraph equipment receiving photographs from Bermuda over the international network of Cable and Wireless Ltd.

The exhibits of individual firms or Government departments will not be grouped together as in a trade fair, but will be arranged in a logical order based on subject matter. Because space is restricted, the Festival authorities have had to confine full-size exhibits to the most interesting and modern electronic products from Britain. These include a pulse multiplex radio demonstration and an ingenious adaptation of the TV camera tube to a new role—that of view-finder for a film camera. But the overall display, including models and photographs, will tell a comprehensive story of electronic developments in Britain.

The CPS Emitron TV camera will be shown in its latest portable version in a closed circuit demonstration, using the new European standard of 625 lines, 25 interlaced frames per second, and a band width of 5.5 megacycles per second. One link in this demonstration will be a transportable centrimetric transmitter giving an output power of 3 watts at 6 cm.

The modern application of radio-activity to industry and medicine forms the climax of a section on atomic science, which will be part of the display in the vast Dome of Discovery whose unsupported span of 365 ft. (111.25 metres) is already an impressive feature of the London skyline. The word discovery is being liberally interpreted to cover a wide range of exploration—tropical, arctic, astronomical, and so on. The section on the physical sciences will describe the work of British physicists, past and present, including the famous school of Lord Rutherford at the Cavendish Laboratory, Cambridge. It (the Physics Section) also sets out to show how the laboratory work of Faraday, Maxwell, J. J. Thomson, and other "giants of the past" has led to the countless applications of electrical technology in modern life. This will be illustrated by demonstrations of high frequency heating, electro-medical apparatus, an electronic computer and a variety of electrical instruments.

It goes without saying that in a 20th century exhibition the electronic common services will be interesting and complex. Thus the South Bank will be very thoroughly wired for TV transmission and reception. Cable ducts terminating in all the main buildings will provide rapid hook-ups for outside broadcast programmes and the Royal Festival Hall, occupying a central position on the site, is the first major building of its kind to be planned with the requirements of TV cameras in mind. In this building there will be a permanent TV control room, handling the programme material which originates in the exhibition.

Received programmes are to be distributed by cable to the "telecinema" and to the many TV receivers which will be working in a number of pavilions, such as "Homes and Gardens," "Transport and Communications," and the Dome of Discovery. Additional circuits will be installed to telephones, the public address network and crowd counting equipment. All told the wiring and electronic equipment of the South Bank will be extremely complex.

There will also be in London an Exhibition of Science,

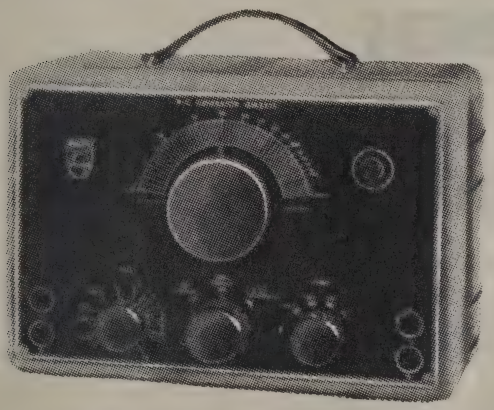
(Continued on Page 48.)

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

PHILIPS AUDIO GENERATOR, GM 2315

This audio generator is based on the R-C principle and is for use in service workshops for the testing of L.F. amplifiers, the external modulation of H.F. oscillators and innumerable other applications in radio and sound service where audio response is of importance.



The frequency range is divided into three: 20–200 c/sec., 200–2000 c/sec., 2000–20,000 c/sec.

Other brief specifications are—

Frequency Accuracy

After the apparatus has reached its working temperature the frequency tolerance is less than 5 per cent. whilst the reading error is less than 2 per cent.

Frequency Stability

With a mains voltage fluctuation of 5 per cent. the frequency variation is less than 0.1 per cent. The variation after 10 minutes heating up is less than 1 per cent.

Output Voltage

This is variable between 0.5 mV and about 10v. by means of a step attenuator with positions 0.001–0.01–0.1–1 and a continuous voltage regulator (0–10).

The accuracy of the attenuator is about 10 per cent.

Max. output impedance, 7000 ohms.

Distortion

In the range from 35 to 20,000 c/sec. the distortion is less than 1 per cent.

Hum Voltage

This is less than 0.5 per cent. At frequencies equal to the mains frequency or multiples thereof it may be about 3–5 per cent.

Power Supply

The unit may be operated from a Philips 6v. D.C. to 220v. A.C. Vibraphil power supply, GM 4226, or from 230v. A.C. mains through a built-in universal transformer with voltage adaptor for 110, 125, 145, 200, 220, and 245v. (50–100 c/sec).

Power consumption about 30w.

Dimensions

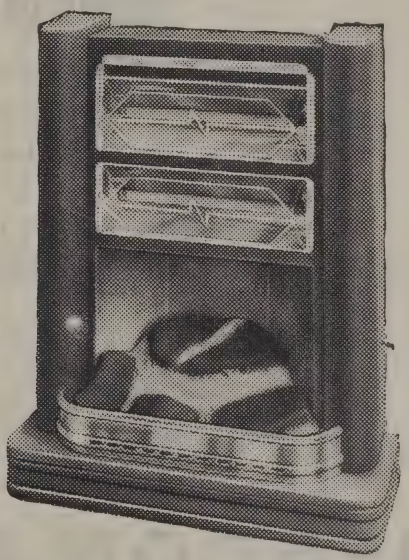
Width: 10 in.

Height: 7 in.

Depth: 5½ in. including knobs. Weight: 11½ lb.

THE ULTIMATE MODEL 310 COAL FIRE

The Ultimate Imitation Coal Fire illustrated here is claimed a triumph for its designers and is a sensationaly new and economical system of space heating. It has 2000-watt direct radiation elements and the convector section, which cannot be seen in the photograph, contains a 275-watt concealed element cleverly placed in a specially designed air channel.



The convector draws in cool air from the face of the fire, heats it, and forces a warm stream into the far corners of the room. The new Ultimate Coal Fire is attractively finished in featherwave with chrome plated post pieces and hobs. Especially built for the modern lounge, the fire achieves remarkable effect by its realistic coal fire action. Switches give individual element control.

The latest improvement is the use of a newly-designed plastic imitation coal which will not deteriorate with age or heat.

Specification

Rating: 2275 watts, 230 volts (2 single 1000-watt bars, 1 single 275-watt convector bar).

Power cable: Six feet flexible cord, with 3-pin plug attached.

Colours: Ivory, bronze, or silver.

Price: £15 5s. retail.

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WELLINGTON	NEW PLYMOUTH	DUNEDIN	CHRISTCHURCH

The Annual Meeting of the New Zealand Radio Traders' Federation

History was made for the Radio Traders on the occasion of their 1951 Annual Meeting, by having a conference away from Wellington for the first time. The locale chosen was the Chateau Tongariro, where the conference took place on 27th and 28th April, 1951. The conference was attended in considerable strength, with delegates and members from the Auckland, Wellington, Hawke's Bay, Wanganui, and Otago associations. Proxies were held on behalf of the Southland, Canterbury, and Manawatu associations, so that, all told, the gathering was a truly representative one.

The agenda was of considerable length, each item being of national concern and importance, and it spoke well for the able handling of the meeting by the chairman that all these matters were fully discussed and action taken in the short time available.

There was a remarkable spirit of co-operation about the proceedings, and although discussion was at times a little lively, to say the least, it was clear that everyone present had the interests of the trade at heart, and was prepared to sink personal or regional differences for the common good. Associations and federations of the nature of the Radio Traders' Federation often seem to suffer from a certain disinterested attitude on the part of their members, and it was most heartening to observe the keenness of all present not only to further the specific matters that were down for consideration, but to extend the sphere of influence of the Federation, and to strengthen its hand by a real spirit of unity among its members. Those individual traders who do not belong to the constituent associations that make up the federation would probably have been very much surprised, had they been present, to learn just to what extent the federation fights the battles, not of its members, but of the whole trade in New Zealand. One thing that non-members often fail to realize is that the existence and activities of the federated traders' associations bring them direct, as well as indirect benefits, in the shape of improved trading conditions, whether or not they lend their personal and financial support to the organization, and that they have a moral obligation to give that support to a body which exists for their good as well as for that of the existing members. A perusal of the report below, recounting what has been done, and what is being attempted by the federation should make all traders realize that the federation is a live and influential body, and that to pursue collective courses of action in matters affecting the trade as a whole costs time and money. The time is given freely, and at no cost, by those enthusiasts who realize the value of the work, but the money must come from the subscriptions of individual traders to their local associations. It can come from nowhere else, and this journal is satisfied that much more could be done were more individual traders to take an interest in the affairs of the Radio Traders' Associations, and therefore in the Federation.

PRESIDENT'S WELCOME

In welcoming delegates to the conference, the President, Mr. J. Fairclough, spoke of the value of holding such a conference away from normal places of business. Everyone present was able to give his whole time to concentration on the matters to be discussed, unhampered by ordinary business interruptions, which are bound to occur when a conference is held in one of the main centres. The more intimate atmosphere engendered by the closer social contact outside the conference room facilitated free informal discussions, which had favourable repercussions on the more formal deliberations at the conference table. It was hoped, he said, that the present meeting would be the forerunner of many similar conferences, which would not fail to cement the solidarity of the Federation, and add to its effectiveness. Mr. Fairclough extended a special welcome to Messrs. W .D. Foster and C. H. Roser, of *Radio and Electronics,* and expressed his pleasure at the good job of work the magazine they represent does for the radio trade. He hoped that much of the conference's deliberation would be of sufficient importance and interest to warrant publication.

In replying to the Presiednt's address of welcome, Mr. Peoples (Auckland) said that now was undoubtedly a time when the trade must consolidate itself as much as possible. On behalf of the Auckland association, Mr. Peoples welcomed the visitors, and wished them a pleasant stay.

Present at the conference were: Mr. J. Fairclough (Napier), Mr. H. C. Osborn (Otago and Southland), Messrs. D. B. Billing, N. Souper, W. Young, and J. Burns (Wellington), Messrs. S. Christie, C. Peoples, J. Beachen, W. Murphy, H. Barr, and M. Rhodes (Auckland); Messrs. D. Chew, and J. Hodge (Wanganui); Mr. P. J. Luxford (Secretary), and Messrs. W. D. Foster and C. H. Roser (*Radio and Electronics*).

Apologies for absence were received from Messrs. Griffiths (Nelson), Borham (Manawatu), Gillick (Otago), Markby (Canterbury), and the National Carbon Company Ltd. (Wellington).

The first matters of business were of a routine nature, comprising the confirmation of the minutes of the previous Annual General Meeting, and the presentation by the President of the Annual Report and financial state-

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ment. As the Annual Report, covering the Federation's activities for the year was reported in the April issue of this journal, it is not intended to refer further to it here. Suffice it to say that the Executive has had a very full programme of work before them, and has dealt during the past year with such important matters as the presentation of a case to the Board of Trade for the importation of certain key types of radio condensers, the presentation of a similar case concerning radio and hearing-aid types of dry batteries, the production of a trade-in booklet for the guidance of traders, and of a list of *bona fide* radio dealers, and representation in the Conciliation Council deliberations with regard to a new award for radio workers.

During the discussion on the annual report, it was moved by Mr. Billing, and seconded by Mr. Rhodes, that the Federation take steps to obtain from the Customs Department the statistics relating to the importation of radio components. This information is available on payment of a fee, and it was felt that it would be most valuable to members. The motion was carried, with the additional rider that the information should be attached to the Annual Report as a means of circulating it to members.

GENERAL BUSINESS

Condenser Imports

After Mr. Billing had, at the request of the chairman, outlined the negotiations entered into by the Executive with the Board of Trade, to which the Federation and Messrs. Ducon (N.Z.) Ltd. had submitted their respective cases, speakers paid tributes to Mr. Billing's work in this connection, and expressed their full confidence in the manner in which the Executive had handled this important matter.

The Federation had received a letter from the Board of Trade referring to their previous submissions, and asking the Federation to supply factual (*i.e.*, documentary) evidence of their previous claims that members of the Federation are unable to obtain import licences for essential condensers, even of those types that are not manufactured in New Zealand. After considerable discussion, a resolution was passed "that the Federation again approach the Board of Trade in connection with the importation of condensers."

Dry Batteries

A lively discussion took place on the question of the shortage of radio and hearing-aid dry batteries. Mr. Billing outlined the proceedings at the last meeting of the Wellington Association, at which representatives of the National Carbon Company attended and discussed the question with the Association, and the Secretary read the letter which the Federation had sent on 12th April, 1951, to the Board of Trade, requesting import licences for these classes of battery. A number of speakers took part in the discussion, and all emphasized the invidious position of the trader, who was rightly regarded as having an onus ot supply replacement batteries for the battery receivers he has sold, if he is unable to supply the customer. One speaker thought that insufficient of the batteries that were available were allocated to retailers, which aggravated the position, because it meant that in spite of the shortage, more new

When you sell a radio set, remind your customer that the better the set the greater the need for a first-class anti-interference aerial. The "EXSTAT" Aerial is designed to cut out the annoyance of electrical interference and to ensure crystal-clear reception at the receiver.

"EXSTAT" has a proven record of service in town and country, and is an ESSENTIAL FITTING for all showrooms.

The "EXSTAT" Aerial

EXSTAT Model ASA 112 comprises 15 ft. vertical rod with lashing mounting, two transformers, and 60 ft. of screened cable.

Retail Price, £8 18s. 6d.

Model ASA 100, as above, less rod and mountings. Retail Price, £5 5s.

Model VRA 112, vertical rod aerial, less transformer. Retail Price, £3 9s.

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20 BOND STREET, WELLINGTON

sets were fitted with batteries and sold, which in turn increased the potential market for replacement batteries. It was also stated that the Australian factory of the National Carbon Company, which makes all the radio B batteries of the kind under discussion, was unable to catch up on present demands, which could only be supplied by importation. After discussion, it was resolved to meet the Department of Industries and Commerce in connection with the battery shortage, and, if satisfaction were not obtained, to seek an interview with the Minister on the subject.

Television

Led by Mr. Young, a lengthy discussion took place concerning the difficulties that had been and were being created by the publication in the daily press of statements that television would be coming to New Zealand very soon. It was felt that a great deal of harm was being done to the trade by these press reports, which as often as not were reported statements by travellers returning form overseas, who had no knowledge or authority to speak on TV other than having viewed a few programmes. It was felt that the public needed to have the true facts placed before them by someone whose bona fides could not be questioned, so that they can be brought to realize that broadcasting and TV are entirely separate media of entertainment, to be used and enjoyed quite separately from each other, and that in any event, the only places in the country that could expect to be covered by TV for very many years were the four main centres and their immediate environs. The suggestion was put forward that retailers should have some printed matter available to give prospective customers who might be hanging back because of mistaken ideas about the role and probable extent of TV, and that this material could well take the form of a brochure, written by some person outside the trade, but who is qualified to speak, and whose pronounced opinions can carry weight. The brochure could, and should, it was felt, be issued by the Federation, under its own insignia, and that retailers would benefit considerably thereby. The cost of a suitable leaflet would not be great, and retailers could well afford to distribute a hundred or more, according to their clientele.

After discussion on the pros and cons of taking such a step, the following motion was carried: "That this meeting agree to produce a brochure under the seal of the Federation, to be edited each 12 months, giving the true facts about television, and that the brochure be distributed to associations at cost, and that Mr. Foster, of *Radio and Electronics,* be asked to prepare the material and arrange for its production."

Trade-in Booklet

The Chairman informed the meeting that copies of this booklet would soon be available, and referred to the fact that the Otago association did not agree with the formula used by the Executive in working out the values given. Speakers then indicated that some associations did not agree with the basis of formulation, but agreed that the book was a good thing, and said that their associations would subscribe to it, while retaining the right to modify the schedule to suit local conditions. It was pointed out that the use of the price schedule contained in the book could not be mandatory, but was rather intended to lead to a common basis for estimation of the trade-in values of sets, that would tend to achieve something in the nature of uniformity among dealers all over the country.

Register of Bona Fide Dealers and Servicemen

The Secretary advised the meeting that the list was now stencilled and would be issued within a few days. It was proposed to issue monthly supplements in order to keep the list up to date. Mr. Billing suggested that local associations should set up committees to "vet" the lists and to submit amendments to the Secretary each month. The cost of the original list, and of the monthly supplements was agreed upon as 10s. per annum.

Missing or Stolen Radios

Mr. Beachen outlined a scheme which is in operation in Auckland whereby the association is supplied by the police with all their information relating to missing or stolen radio sets. This information is then circulated by the association to its members, and suggested that the scheme could possibly be extended. The meeting agreed that the system was an excellent one and that lists should be compiled on a national basis, and circulated to local associations.

Trading Practices

The practice of certain firms in giving away other goods as an incentive to purchasing a radio set was fully discussed by the meeting. Under this heading came the question of power boards entering the electrical trading field, not only with appliances, but also with radio sets, and the fact that one power board had been reported as issuing provisional wiring licences to apparently unskilled employees, to the detriment of those regularly engaged in business. It was felt that little could be done about the established practice of some firms in giving away goods as a form of discount, nor could manufacturers be prevented from supplying sets to dairy companies and other firms, but that these firms and others not regularly engaged in the radio trade should be pre-

vented, if possible, from under-selling the normal retail price, and thus coming into unfair competition with the local radio dealers. On the mtion of Mr. Christie, it was resolved that the true facts with regard to the power board mentioned above be ascertained, and that should these justify further action, the matter be taken up by the Executive with the State Hydro-electric Department. Finally, on the motion of Mr. Billing, and seconded by Mr. Peoples, it was resolved:

"That this Federation place on record that its policy is against unfair trading practices of any kind, including premium selling, power board trading, and sales to organizations that resell at less than the prescribed retail price."

Radio Interference

The important question of interference was considered at some length, the Secretary reading out correspondence from the Post and Telegraph Department on the subject, and reported that the advisory committee originally set up in 1934 was to be re-constituted, and was to resume active work. Mr. Billing reported that a meeting to this end had already been called on 5th April, 1951, and that he had attended to represent the trade. Mr. Billing explained that the minutes of this meeting and proposed constitution of committees were not available for discussion because the proposals made at the meeting had not yet received ministerial approval but would be available at a later date. During the discussion, it was pointed out by one delegate that a major difficulty in attempting to track down individual causes of interference was the lack of knowledge by the public, who were just as likely to put down certain types of interference to "static." Those able to identify particular interferences were generally able to get quick and effetcive action from the authorities. After the discussion, a motion was carried that the Minister of Broadcasting, the Postmaster-General, and other authorities should be approached with a view to having suitalbe new legislation framed, and that consideration be given to approaching the P. & T. Department with a view to simplifying the form which the public is expected to fill in when making complaints of interference.

Import Control

In view of the fact that the Board of Trade had recently announced its decision to de-control importations of radio sets, the Federation's official attitude to the matter was given considerable attention. A remit from the Otago Association was placed before the meeting by Mr. Osborn and read as follows: "That the Federation supports the lifting of control on the importation of radio sets, with provision for protection by tariff rates for New Zealand manufacturers." On the seconding of

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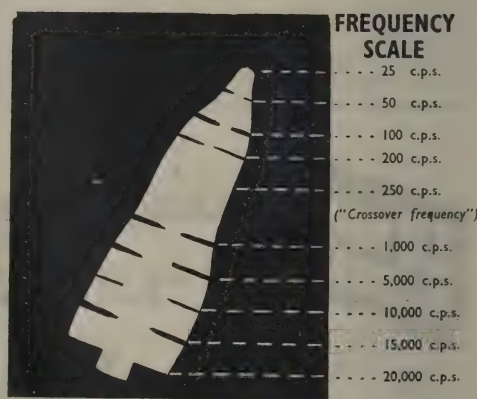

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the remit by Mr. Burns, considerable discussion ensued and showed a rather wide divergence of opinion among delegates. Associations had not had sufficient opportunity of discussing the matter, and it was felt that as a result the meeting was not competent to frame a resolution. On the motion of Mr. Young, it was decided to refer the remit to associations for their urgent consideration, and that they should be asked to communicate their views to the Secretary as soon as possible.

Election of Officers

The meeting paid a tribute to the President, Mr. Fairclough, and in re-electing him to the office, commended the able and willing way in which he had handled Federation affairs during the past year. Mr. Fairclough, in reply, thanked the meeting for their expressions of appreciation, and said that if any reward was due him, it was in hearing such opinions expressed, which made him feel that he had done the job he set out to do. This, he said, was simply to do all he personally was able to further the aims of the Federation.

The other officers were elected as follows:—

Immediate Past President: Mr. G. J. Markby.

Executive: Mr. E. B. Borham (North Island Minor Associations); Mr. A. K. Griffiths (South Island Minor Associations); four members to be elected by the Auckland, Wellington, Canterbury, and Otago Associations respectively.

Mr. G. Y. Berry was re-appointed as auditor, and the office of the New Zealand Employers' Federation was re-elected as Secretary-Treasurer.

Federation Rules

As the last item on the agenda, a new set of rules, prepared by the Auckland Association, was discussed. The conference went into conciliation to consider the proposals, the most important of which concerned a change in the voting strength allotted to individual associations at all general meetings of the Federation. After discussion in conciliation, the conference was resumed, and resolved to adopt the recommendations made in conciliation. These were to the effect that associations with more than 100 members should have four votes, associations with over fifty and less than 100 should have two votes, and associations with up to fifty members, one vote. Also that any association may appoint a proxy for attendance at Executive meetings. It was then decided that the Executive should consider the proposed new rules in detail, and that after final decisions have been made by member associations, the rules should be printed and circulated to member associations.

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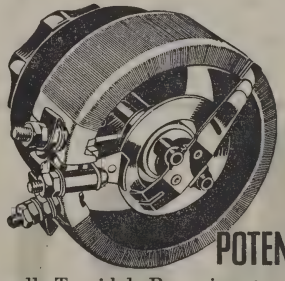

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Cressall Toroidal Potentiometers are wound on a heat-resisting ceramic former and are produced in two types: R50 (50 watts) and R100 (100 watts), and also 4 and 6-watt units, both line and insulated spindle. The larger types can be supplied as double or trplie-ganged units with simultaneous drive. "Off" position types and slow-motion drive also available. Wide range of Toroidal Wire Wound Potentiometers held in stock; also resistance grids and sliding resistances. Made by the CRESSALL Manufacturing Co., Ltd., England.

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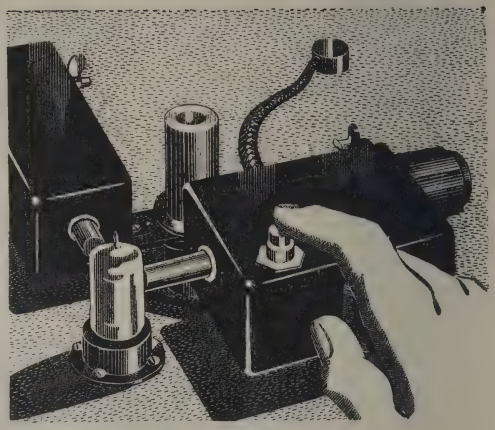
Test illustrated here shows valves undergoing vibration tests. Hammers strike the valves alternately from directions at right-angles, whilst meters record the effect on valve characteristics. This ensures that each Brimar Valve will give long and continuous satisfaction under the most arduous conditions . . . perfect radio performance.



Some of the valve types available here in New Zealand are:

	R.F. Tubes	Mixer Tubes	I.F. Tubes	2nd Detector	Output Tubes	Rectifier Tubes
1.4v. Battery Types	1T4	1R5	1T4	1U5	3V4	—
6.3v. Loctal Types	7H7	7S7	7H7	7K7	7C5	7Z4
6.3v. Octal Types	6K7GT	6K8GT	6K7GT	6B8GT	6V6GT	5Y3GT
6.3v. All-Glass Types	6BA6	6BE6	6BA6	6AT6	6AQ5	6X4

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TRADE WINDS

PHILIPS ELECTRICAL INDUSTRIES OF NEW ZEALAND LTD. ANNUAL SALES CONFERENCE

Seated, left to right: H. Valentine, E. Undrill, W. L. Farquharson, N. M. Percival, L. Lord, R. A. Nisbet, H. T. Perkins, R. Slade.

Standing, left to right: J. H. Gasson, A. C. Crawford, G. Kende, M. Harding, A. I. Webb, W. F. Kerr, G. Sparrow, A. P. Gregg, F. C. McNeil, G. Laurie, F. L. Fuller, E. Jamieson, A. G. McMillan.

The above photograph was taken during the recently completed annual sales conference in Wellington of Philips Electrical Industries. The conference which occupied a full week of serious discussions covered all phases of Philips activities in the lighting, radio, and electronic fields, and was attended by the Branch Managers of the four main centres together with the head office sales groups and factory representatives. The company has made rapid progress in New Zealand following the war years and the trading changes made during recent years have been fully justified by the substantial increase in sales and the improved distribution service available to the company's clients.

All article groups in presenting their reports of the last year's trading and trends showed an exceptionally healthy picture, while the programme detailed for the current year indicates that the company is going from strength to strength.

The frank exchange of views proved beneficial on several of the many aspects of trading and the conference ended on a very confident note.

On the lighter side was the screening, one evening, of a selection of Philips films while towards the end of the conference Mr. and Mrs. R. Slade entertained the visitors and the company's executives at a cocktail party at their residence in Karori.

PHILIPS CELEBRATE THEIR SIXTIETH ANNIVERSARY

It was on 14th May, 1891 that Gerard Philips first opened the doors of what is now the vast world-wide Philips organization. During May, 1951, exactly sixty years later, Philips New Zealand commemorated this event by a series of events which focused attention on this historic occasion. During these celebrations the staff and all employees of the company were the guests of the management at a house party held in the Roseland Cabaret, Wellington.

All members of the Philips staff were present together with representatives of various business houses which are closely associated with the company and everyone appeared to have joined into the spirit of the occasion.

In proposing the toast to the company's co-founder and present Chairman of Directors of the vast Philips concern, Dr. Anton Philips, the Managing Director of Philips New Zealand, Mr. L. Lord, traced the development of Philips from the company's inception in 1891 to the present day and in doing so stressed the point that a vital feature of the company's greatness is the team spirit which pervades the whole organization throughout the world and which, in effect, creates one great international family. Mr. Lord was followed by Mr. E. Undrill and Mr. F. C. McNeil (Mr. McNeil deputizing for Mr. Ralph Slade, who was recovering from a bout of the flu), who both spoke briefly on behalf of the production and commercial departments respectively.

Mr. J. H. Brookes, on behalf of the parent organization, acknowledged the toast, and when responding spoke of the great affection and respect which all employees of Philips, especially in Eindhoven, had for Dr. and Mrs. Philips. This well-loved pair have always taken a very keen and personal interest in the welfare of their employees and it was due to this fact that the Philips organization was one of the first in the world to provide comprehensive welfare facilities for their employees. In knowing Dr. and Mrs. Philips personally, Mr. Brookes said he was certain that they would be very proud and happy to know that even in this, the most southerly country in which the Philips concern is organized, we were celebrating the anniversary of the founding of the organization which has been so much a part of their lives in the past 60 years.

An excellent buffet supper was available and for those who wished to trip the "light fantastic" a splendid orchestra provided music. Taken all in all this memorable function achieved its purpose in adequately commemorating the anniversary of an outstanding organization.

* * *

Noel Laird, who left recently for an extended business trip, writes that having spent two weeks in Sydney, one in Melbourne, and another in Perth, has proceeded to the United Kingdom.

Correspondents' attention is called to the change in the *R. and E.* Post Office Box number, which is now 8022, Wellington.

* * *

New Zealand Manufacturers' Federation headquarters have now removed to 89 Courtenay Place, Wellington, and whilst their P.O. Box remains unchanged, the telephone number is now 54-684.

* * *

Chris Matthews has had a short vacation in Dunedin.

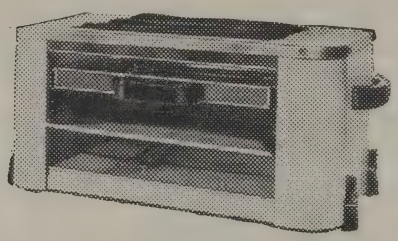
* * *

Peter Tucker, after a spell in hospital, is back on the job and we are pleased to say, looking very fit.

* * *

One of the many ways in which Philips Electrical Industries, Eindhoven, Holland will be celebrating their diamond jubilee is the use of the first day issue of the Netherlands "Summer" Stamps (a special series issued every year, the proceeds of which go towards funds for cultural purposes). The use of this stamp by Philips will constitute a unique postal rarity, for a quantity of postcards, with the first day issue thereon, will pass through the only official post office to be set up by a private firm in the Netherlands. This post office is in the headquarters of Philips, Eindhoven, where it operated its own cancelling mahines using a stamp bearing the name Philips. As the issuer of the "Summer" stamps coincides with the official date of Philips sixtieth anniversary, *i.e.,* Tuesday, 15th May, a special cancellation stamp has been designed to be used by Philips post office. Never before in the Netherlands, nor it is believed, anywhere else, have special stamps been used for an event occurring in a private business firm. Some of the postcards will be sent to New Zealand, so it is expected that stamp enthusiasts amongst the radio trade will eagerly look forward to this mailing.

THE ULTIMATE BREAKFAST GRILLER



A description of this new Griller was featured in the May issue, New Products, on page 42.

Jim Eckford in May paid one of his periodical visits to the capital city, calling on *R. and E.* for a chat on what's cooking for the constructor.

* * *

Another Aucklander to call at *R. and E.* was Brian Terry and, as usual, was full of salesmanship ideas.

* * *

P. C. Collier is back after a short business trip to Australia.

* * *

GIFTS TO R. & E. LIBRARY

Mr. Ian L. Taylor of Hawera has sent us three bound volumes of the *N.Z. Radio Times,* a monthly paper which served the Radio Industry Traders, amateurs DXers, etc. for approximately eight years prior to the last war. A quick perusal of the pages makes most interesting reading, particularly in prediction of things to come and might have come but for the war. What so-and-so said in those days, pictures of celebrities now not so young, all reviving memories of many now away from active interest in the trade, etc. Should any reader care to take a view of these volumes a welcome awaits him at our editorial offices. Our best thanks to you Ian for your presentation.

PUBLICATIONS RECEIVED

Westinghouse Engineer, March 1951.

Descriptive catalogue, "Mullard Valves for Television" (C. & A. Odlin, Ltd.).

"The Video Output Stage," by E. T. Emms, B.Sc., A.M.I.E.E., of Mullard Electronic Research Laboratories (C. & A. Odlin, Ltd.).

"Radiotronics," April 1951 (Amalgamated Valve Co., Pty., Ltd.).

* * *

Appearing elsewhere on this page is an advertisement for R. and E. Binders. As with all other commodities cost of production continues to rise—printing charges being no exception. Fortunately, we have been able to keep the price of our magazine down to what it was three years ago and we hope still to do this not by stinting reading matter but by increased efforts on our part to improvise efficiency in our organization. Thanks to the support of our advertisers whose goodwill enables us to produce our paper and maintain it in a high level, we have not yet had to increase our advertising rates. Our circulation grows steadily and that help keep costs down. We are, however, at the point where certain costs must be passed on and this applies to Binders for R. and E. To enable our subscribers still to have a binder at reasonable cost it has been decided to make one price only, namely 5s. 6d. As most subscribers got in early with their quantity orders no hardship is expected in that direction, and we are confident that the binder we have supplied at the small figure of 5s. was splendid value and now at 5s. 6d. is still grand value.

Be sure and order your binder for Volume 6, which starts with the March issue. Don't delay; who knows prices may rise again?

Binders for "Radio and Electronics"

Our stocks have lately been exhausted, but further supplies have now come to hand. We very much regret to advise subscribers that printer's charges for further supplies have so risen that we have to raise our prices, too, but so as to keep the cost of single binders within reason we have been forced to discontinue discounts on quantity copies.

Kindly note new prices for binders:

Single Binders or quantities, 5s. 6d. each.

Please remit cash with order and print name and address clearly. Address to:

"RADIO AND ELECTRONICS,"
P.O. Box 8022, Government Buildings,
WELLINGTON

New Developments in Radio Components

By TREVOR WILLIAMS

Deputy Editor of the Scientific Quarterly magazine *Endeavour* (London)

The immense expansion of the radio industry which has occurred during recent years—and particularly as a result of the pressing technical demands of World War II—has resulted only in part from new scienctific discoveries. No less important has been the production—generally the mass-production—of the vast number of different components which are needed to translate them into practice under the very varying conditions which are encountered in actual use. A recent exhibition in London of radio components gave—by collecting the main products of all the leading firms under one roof—an impressive picture of the vast range of individual items now being made in Britain.

From so complex a collection it is difficult to single out items for special mention, but two important trends are very clear. On the one hand great attention has been paid to the sealing of all kinds of components to make them impervious to climatic changes, dust, damp, and so on. The second major change which can be discerned is one towards producing all kinds of components in very small sizes. This development is of particular significance to the aircraft industry. Modern aircraft have to carry so great a range of radio and electrical equipment—receiving and transmitting sets, radar, instruments, and so on—that the weight would be quite prohibitive if ordinary equipment was used and space could not be found for it all within the fuselage. Only by the use of miniature components can all this mass of equipment be carried.

Typical of exhibits which reflect the tendency to both greater robustness and smaller size is a rotary switch no more than three-quarters of an inch (19 millimetres) in diameter. Although it is so tiny it will work under the most severe conditions and in tests has been found capable of making more than a million movements without failure. Another important field for midget components is in the manufacture of hearing-aids. One development here is a dry battery weighing only half an ounce (14 grams). For those who like individual listening to radio programmes there are miniature loudspeakers which can be fitted as exensions to the receiver.

FLOATING ON AIR

One extremely interesting exhibit showed a novel device for handling very thin steel sheets. By magnetic means the sheets are made to repel one another so that the top sheet of a stack virtually floats on a layer of air and can be detached without the slightest difficulty. By this means the operator can handle the sheets no less than three times as quickly as when each sheet has to be carefully separated by hand.

Another exhibit shows that even in fields where there is apparently no further room for improvement, improvement can yet be made. This concerns soldering, the commonest of all operations in assembling radio equipment.

Efficient soldering of joints is absolutely vital and to mark all joints which have been completed it is customary to dab them with a spot of coloured lacquer. In view

Supplies Drying up ? Costs Rising ? SHORTAGES

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CONDENSERS, Variable, 2-gang, 420 mmfd.
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CONDENSER RESISTOR LOOM, 4 25 mfd. 25v. Electros, 8 Resistors on Mtg. Board, plus quantity of Hook-up Wire—
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CONDENSERS, Fixed Tubular, 400v.—
.02 mfd. Cat. No. EX1027 ..... 6d.
.1 mfd. Cat. No. EX1028 ..... 9d.
.25 mfd. Cat. No. EC715 ..... 1/3

SPACERS, Cadmium plated, ¼ in. long, ¼ in. dia., 3/16 in. hole—
Cat. No. EX1198 ..... 1d. ea., 6d. doz.

1 in. long, 3/8 in. dia., 3/16 in. threaded hole—
Cat. No. EX1146 ..... 2d. ea., 1/6 doz.

ALL-METAL TERMINALS, Non-insulated, oxidized Radio Terminals Threaded headpiece and washer screwing down on to base washer makes for sure connection. 4BA x 3/8 in. stem allows ample room for attaching insulated washers if terminal is required to be insulated—
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of the very large number of soldered joints which often have to be made, however, this is a tedious and time-consuming operation. In a new type of solder colouring matter is included in the central core of flux so that each joint made is automatically coloured in the soldering operation itself.

Not unexpectedly, in view of the present world situation, many of the components shown were ones developed for the armed forces. Many were exhibited by experimental establishments of Britain's Ministry of Supply and the Admiralty Signals and Radar Establishment. From the Atomic Energy Research Establishment at Harwell, Southern England, were sent 15 exhibits associated with the detection of radiation, ranging from insulators intended for a pocket dosimeter for civilian use to high-speed particle-counters. The Telecommunications Research Establishment at Malvern, in the West of England, displayed many new components and methods and the replacement of radio valves by new devices such as magnetic amplifiers.

TOWARDS STANDARIZATION

Very great efforts are being made by the Radio and Electronic Component Manufacturers' Federation (R.E.C.M.F.), together with the other member associations of the radio industry, to rationalize the whole component field. This is being done firstly by issuing a series of specifications, of which 19 have been published and several others are almost complete, covering various components. It is intended that these specifications, together with those of the armed forces, shall be examined, co-related by a joint committee from the industry and the armed services, and then issued by the British Standards Institution.

In addition a wealth of material was displayed which was designed for the more familiar branches of the industry—those manufacturing radio and television sets for domestic use. It was scarcely surprising to learn that Britain has become the world's leading exporter of loose radio components. The value of exports in 1950 was no less than £9,000,000, or three times as great as in 1946. Some two-fifths of these exports go to the countries of the British Commonwealth; other major customers are the United States and Brazil.

* * *

AERIAL POLAR DIAGRAM MEASURING DEVICE

Several new products will be shown in the Electronics Section of the Physical Society Exhibition, which is being held in London. One is an aerial polar diagram measuring equipment, developed to provide accurate automatic recording of the polar diagrams of centimetric antennae. The antenna under test is mounted on a rotatable trailer and illuminated by a fixed transmitter, while the amplitude of the received signal is continuously plotted against the angular traverse of the trailer and antenna. The equipment covers a frequency range of from 8,500 megacycle to 9,500 megacycles but any convenient range can be covered by the substitution of two units.

Another new exhibit is a working model of the latest industrial type thickness gauge. Using radioactive thallium 204, it is capable of measuring from 0.0005 (0.0127 millimetres) up to 0.10 inch (0.254 millimetres) of paper or the equivalent weights of other materials.

There is also a new portable radioactive ore detector which has no controls, no inter-connecting cables, except for the headphones, and no electronic circuitry. Weighing only three and a quarter pounds (one and a half kilograms) it may be carried in the hand and used as a probe or slung from the body. It is always ready for use, the only replacement required being the battery whose life, which is independent of use, is between six and nine months in a temperate climate.

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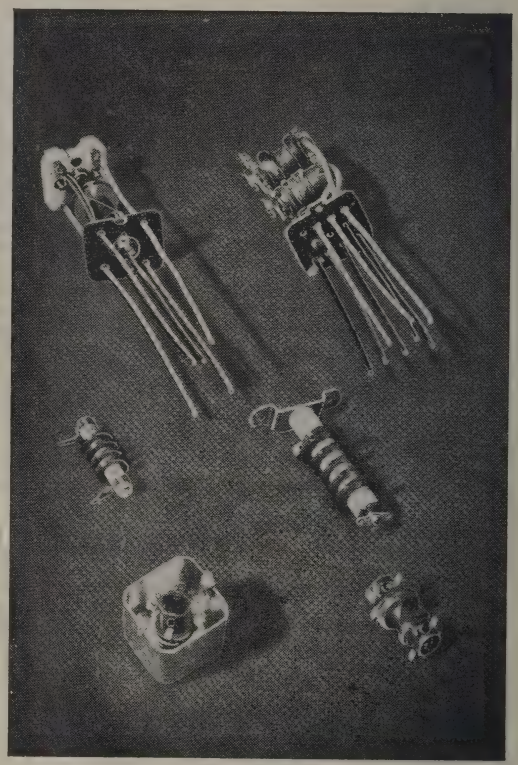

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SOME WAVE-FORMS AND HOW TO MAKE THEM

PART III

In the last instalment of this article, the action was described of a circuit which,, by simply overdriving an amplifier valve, fed with a sine-wave from the secondary of a coupling transformer, produces a square-cornered wave, whose positive and negative portions are of almost equal duration. This time, we describe a circuit which illustrates another slightly different method of overdriving the amplifier valve, but which produces a square-wave whose positive portion lasts much longer than the negative part. The actual wave-forms are shown in Fig. 7, reproduced here, in which the middle pair of waves shows the output, with a timing wave immediately below it, to show which part of the square wave corresponds with what portion of the original sine-wave.

This again is a very simple circuit, and at first it is not at all obvious why it should produce such a different answer from the one of Fig. 2, whose action and output wave-form was illustrated in Figs. 5 and 6. Briefly, the answer is that the different conditions that obtain in the grid circuit can and do account entirely for the difference in behaviour.

ACTION OF FIG. 3

First of all it is necessary to know something about the size of the grid circuit parts, and their relation to the frequency of the sine-wave input voltage, R_g and R_s are grid leak and grid stopper respectively, and in this circuit both have a high value. For example, both can be of the order of 500k., but frequently it is found that R_s is somewhat smaller than R_g. However, this has no effect on the action of the circuit. The next point is the size of the input condenser, C_g, in relation to R_g and the working frequency. Briefly, its value is large. That is to say, its reactance is small compared with the value of R_g, at the frequency of operation. For instance, if low-frequency square-waves are to be generated, it will have to be of the order of 0.05 to 0.1 μf. It can thus be seen that as in audio amplifier coupling circuits, the time constant of the coupling condenser/grid leak combination is long compared with the duration of one cycle of the input frequency. This is important, because it enables the action of the grid circuit, which determines the performance in this case, to be quite readily understood.

First of all, we will not attempt a point-by-point description of the generation of the wave-form, because once the biasing conditions are discovered and understood, there will be no necessity for one. The first fact to be noted about this circuit is that while the valve is unbiased to all appearances, and certainly is so when there is no signal voltage applied to the input condenser, the valve is actually biased very strongly negatively, when a large input voltage is applied. This bias is a kind of automatic bias that is never met with in ordinary amplifier circuits, and which some people find difficult to understand, so that we will have to explain it quite carefully, and probably in two or three different ways. The bias obtained by this method is automatic, as we have said, but it is also directly in proportion to the size of the signal input voltage. And it comes about because the flow of grid current through the grid resistors charges the input condenser negatively. Let us imagine that the action has been going on for some time, so that things have reached a steady state. If we imagine a milliammeter connected in series with the cold end of

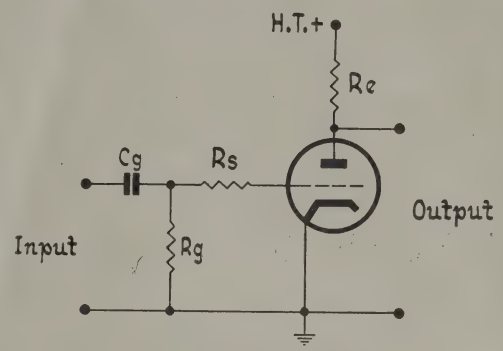


Fig. 3

R_g, we would find that it indicated a steady grid current of a certain number of microamperes.

This current is not actually a steady one, as can be readily imagined, because it takes place only during the positive half-cycles of the input voltage, but the meter reads its average value, and it can be regarded for our present purpose as a steady grid current. We can see from the circuit that this current flows through R_g. It must, therefore, produce a voltage drop across this resistor. Moreover, if the direction of the flow of electrons is considered for a moment, it will be seen that the grid end of R_g must acquire a negative potential. An *average* negative potential, that is, which is as steady, for all practical purposes as if it were produced by a battery. This potential is applied to the grid of the valve through the grid stopper R_s, so that when the signal voltage is great enough to produce grid current, there is a perfectly real negative grid bias on the valve. This bias, due to the grid current, is the grid voltage about which the grid signal swings, and thus represents the datum line for the input voltage. It must thus be only the positive peaks of the input wave that cause grid current to flow. The grid condenser is charged up to a negative potential equal to the grid bias, but, as in all charged condensers, this charge would leak away through the grid leak resistor were it not for the fact that for a small portion of each cycle there flows enough grid current to make up for the charge lost during the time that grid current is *not* flowing. There is, in fact, an equilibrium set up, in which the grid voltage is such that just enough grid current flows during every cycle to counter-balance the loss by leakage from the grid condenser. If for any reason the grid voltage should be less than the equilibrium value, as happens immediately after switching on, then on the next positive half-cycle, more than the final value of grid current flows in exactly the same way as a diode, such as is used as a peak voltmeter, so that the negative bias developed is almost, but not quite, as great as the peak voltage of the input wave. The difference is due to the fact that *some* charge, however small, must be lost by the grid condenser during every cycle, and so this must be made up by grid current at the extreme positive tip of the input wave-form. The higher the value of R_g, the more closely does the built-up bias approach the peak input voltage.

We have gone to some lengths to explain this mechanism, because the action is a very important one, which is used to a considerable extent in oscilloscope and tele-

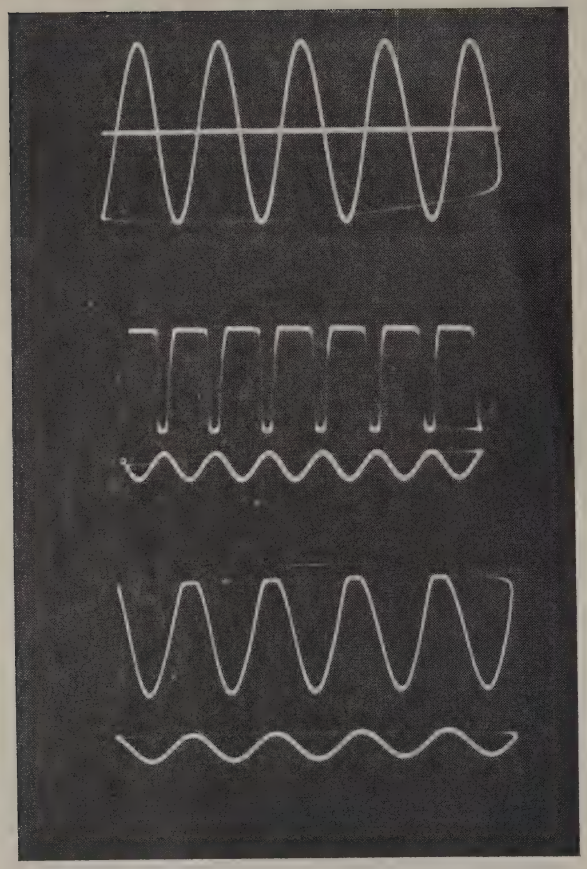


Fig. 7.—Showing some of the wave-forms to be found in the circuit of Fig. 3. Above is the sine-wave input voltage, at the bottom is the voltage at the grid, showing that the grid current just clips the positive peaks. In the centre is the output square-wave.

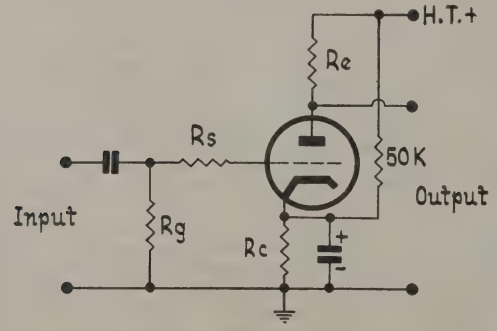


Fig. 4

This is another circuit which gives the same effect as that of Fig. 3, but which does not rely solely on grid current for the high negative bias.

vision circuits. The grid circuit action is identical with that of the so-called D.C. restorer circuit, which uses a diode, with the precise object of automatically inserting a D.C. component into an alternating wave-form. The D.C. component in this case is the D.C. voltage built up across the grid resistor, and is used as a means of biasing the valve. In measuring-diode circuits, it is used as a measure of the amplitude of the A.C. input wave, while in D.C. restoring circuits it is used to prevent the output from having positive values at any time, or to ensure that the signal always has negative values, from earth as a reference point.

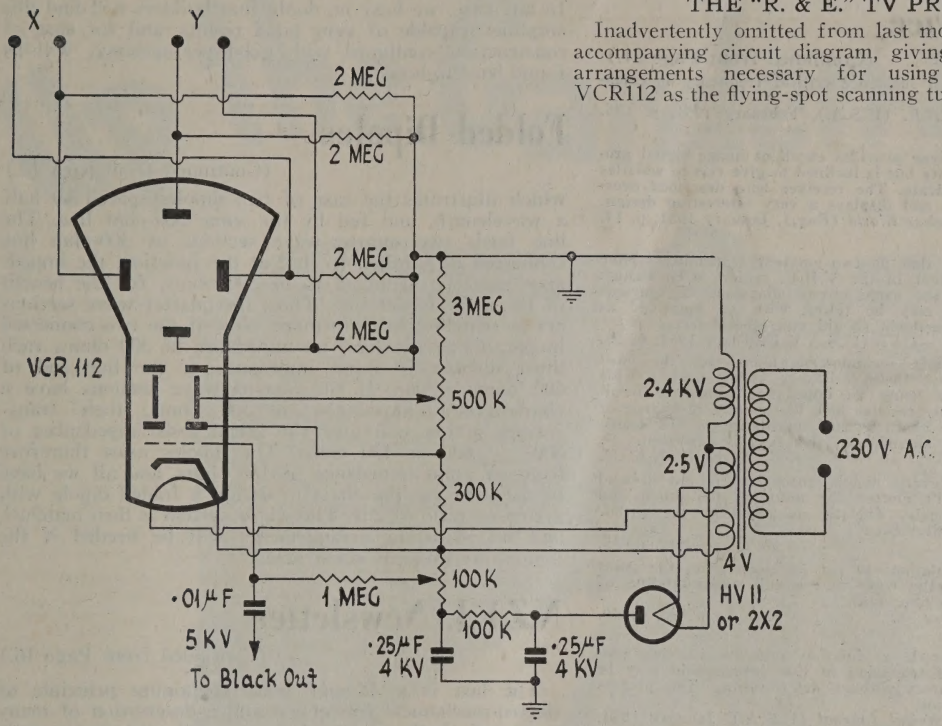
This somewhat lengthy description of the grid action has perhaps rather obscured what we are trying to do with the circuit, but it is easy to see what will happen to the shape of the output wave. It will still have sharp corners, and flat portions top and bottom, but now, the positive flat portion will last for considerably longer than the negative portion. *This comes about solely because of the bias on the valve.* The amplitude of the input is still high, of course, but because only the tips of the positive half-cycles cause grid current to flow, only these same tips will cause the valve to draw plate current too. In fact, by arranging to vary to bias on the squaring valve, we can get a square wave output in which the ratio between the durations of the positive and negative portions is anything we please. This ratio is usually called the mark/space ratio, and is the ratio between the times during which the valve is conducting and non-conducting. The action of the circuit is illustrated in Fig. 7. The two lower pairs of wave-forms illustrate it very well, and bring out the points we have been discussing. At the bottom we have the original sine-wave, and above it, the wave-form at the grid of the valve, after amplification in a normal class A resistance-coupled stage not shown. Here it can be seen that only the very tips of the positive half-cycles have driven the valve into grid current, and have thus been cut off by the same clipping action of the grid stopper as we saw occurring in the first circuit. The middle pair of wave-forms illustrates the output wave. Unfortunately, this picture was taken with a different time scale, but the frequencies are the same, and it can quite clearly be seen that the negative half-cycles, corresponding with the positive half-cycles of the input, are of much shorter duration than the positive ones, which represent the duration of the period during which the valve is cut off. By varying the input voltage, the mark/space ratio can be altered, because the bias is proportional to the input voltage, so that the two are interdependent in this circuit. Another way of varying the mark/space ratio is to make the grid resistor variable, because this will also vary the developed bias, and therefore the period during which grid current flows.

What we would like to emphasize before leaving this circuit is that the essential feature of the arrangement which causes the mark/space ratio to change is the provision of bias for the valve. The rather complex manner in which the deceptively simple circuit provides this bias is really only a secondary consideration, since we will see later that pulses can be produced by biasing the valve in any other of the more straight-forward ways, such as by simply using a battery.

(To be continued.)

THE "R. & E." TV PROJECT

Inadvertently omitted from last month's issue was the accompanying circuit diagram, giving the power supply arrangements necessary for using the C.R.T. type VCR112 as the flying-spot scanning tube.



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Abstract Service

(Continued from Page 21.)

zenith angle and vertical incidence critical frequency is established.
—*Proceedings of the I.R.E.* (U.S.A.), February 1951, p. 186.

RECEIVERS

The double superheterodyne provides excellent image signal protection and high selectivity but is inclined to give rise to whistles which are hard to eradicate. The receiver here described overcomes this disadvantage and displays a very interesting design.
—*Wireless World* (Eng.), January 1951, p. 14.

TRANSMITTERS

It is a well-known fact that no two amateur transmitters have the same harmonic content in the V.H.F. region, even though they were built from the same circuit diagram. If spurious resonances occur they may be tested with an amplifier as described and certain methods should cure the defects.
—*QST* (U.S.A.), February 1951, p. 25.

Adjustable dummy aerials—incandescent lamps for the most part serve very well but their resistance varies over a wide range with current. By using an impedance matching circuit it is possible to make any resistor look like a pure resistance of the same value as the characteristic impedance of the transmission line. A dummy antennae of this type is described.
—*Ibid*, March 1951, p. 33.

The dream of almost every mobile enthusiast is an all-band arrangement that doesn't clutter the auto up too much and can be band-changed easily. The rig described by the author seems to meet these requirements.
—*Ibid*, p. 35.

Some facts about modulation—to get perspective on the point of view of zero axis of the wave and a full understanding of modulation this article is important.
—*Ibid*, p. 49.

TELEVISION

Transmission by pulse-code modulation presents inviting possibilities in the field of television in that information may be relayed by many repeaters without deterioration. The process is here described in outline.
—*The Bell System Technical Journal* (U.S.A.), January 1951, p. 33.

MISCELLANEOUS

Safety precautions—reducing the dangers of fire and shock. In Britain there has been favoured the earthing of exposed metal parts and this and sources of possible dangers, fault conditions, etc., are discussed.
—*Wireless World* (Eng.), January, 1951, p. 2.

Electronics in the Festival

(Continued from Page 32.)

devoted mainly to the concept of structure; in biology the living cell, in chemistry the molecule and in physics the atom. The visitor will pass through a series of "scaling-down chambers," in each of which his surroundings will appear to grow larger by a factor of a thousand, until ultimately he reaches the atomic nucleus. In another part of this Exhibition will be seen Dr. Grey Walter's celebrated electronic tortoises, small battery-powered animals engaged in a search for a light source, of reasonable but not excessive brightness—an occupation which is periodically interrupted by their need to connect themselves to a charging plant to replenish their batteries.

Beginners' Quality Amplifier

(Continued from Page 6.)

one. This can be a simple triode resistance-coupled stage, and a glance through past numbers of this magazine will enable one to find several useful pre-amplifier circuits that can be built up separately, or used as additions to this basic amplifier.

As a last word, let us recommend that although any output transformer can be used with this amplifier, the results will be better, the better the transformer is, and the same remarks go also for the speaker and pick-up. In any case, we have no doubt that builders will find this amplifier capable of very good results, and for ease of construction combined with good performance, will be found hard to beat.

Folded Dipoles

(Continued from page 10.)

which illustrates the case of two dipoles spaced by half a wavelength, and fed by the same 300-ohm line. The line feeds two quarter-wave sections of 300-ohm line connected in parallel, so that at the junction, the impedance must be arranged to be 300 ohms, for the benefit of the main feeder line. Thus, the quarter-wave sections act as matching transformers. Now if the two connected in parallel are to have an impedance of 300 ohms, each must display an input impedance at the line end of 600 ohms. Also, if the quarter-wave sections have a characteristic impedance of 300 ohms, their transformer action will give the aerial ends impedances of $300^2 \div 600 = 150$ ohms. The dipoles must therefore have an input impedance of 150 ohms, and all we have to do is to use the chart to design a folded dipole with a step-up ratio of 2:1. The whole system is then matched, and no adjusting arrangements will be needed if the dipoles are properly constructed.

N.Z.E.I. Newsletter

(Continued from Page 16.)

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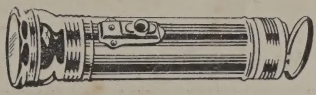

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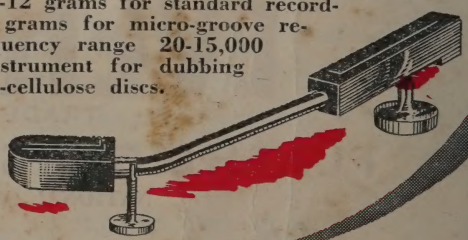

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